THE MODEL ENGINEER

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THE MODEL ENGINEER

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Our Cover Picture

Although the stationary steam engine, as a means of providing power for mills and factories, is rapidly becoming extinct, it still remains one of the most popular subjects for modelling, and information on the design and construction of steam engines is constantly in demand. The engine shown in this photograph is one that has been specially designed for the " M.E." by Edgar T. Westbury in response to many requests, and is described in a new series of articles starting in this issue. In general appearance, this engine follows fairly conventional lines, but it embodies some distinctive features, both in design and methods of construction, and will be found an interesting engine to construct. There are few types of models which serve better as an introduction to model engineering than a straightforward steam engine, which not only provides good exercise in general workshop practice, including machining and fitting procedure, but also serves as a means of demonstrating the working principles of all types of steam engines for marine, locomotive and stationary duties.

SMOKE RINGS

Model Engineering Personalities

SHORTLY BEFORE the war we published a series of brief biographical notes, with portraits, on well-known model engineers, under the title " Who's Who in Model Engineering." The popularity of this feature has encouraged us to revive it, in an up-to-date form, and the first item in the new series will be found in this issue. In the selection of the names, and the priority in the order of their publication, no comparisons of eminence or merit are implied, but we have considered it desirable to begin with some of the senior members of the fraternity whose names are familiar to all readers of THE MODEL ENGINEER. We may say that many of those whose permission has been sought to include them in this series have been reluctant to step into the limelight in this way, and some have modestly declined to accept the distinction. We feel, however, that those who have taken a prominent part in promoting activity in any field of model engineering owe it both to themselves and to the others to make themselves known. Model engineering is a fraternity in the truest sense of the term ; its devotees are drawn not only from every calling, trade and profession, but also from every rank and strata of society. We doubt whether there is any other hobby or pastime in which the barriers of class or creed, profession or nationality, can be so completely broken down ; where else will one find peer and peasant, barrister and baker, joining with equal enthusiasm and energy in discussions or activities of mutual interest ? In these intimate sketches of model engineering personalities, we hope to strengthen still further the bonds of friendship between all members of the fraternity, and bring home to every model engineering recruit the fact that he is " one of the family," and will be made to feel that he is at home in any model engineering circle.

Not Her Usual Locale

AN EVENT of uncommon interest occurred on June 6th when a special excursion train, hauled by an *ex* - Great Central Railway 4-4-0 locomotive of the " Director " class, was run from Retford, Notts, to Windsor, Berks, taking many happy members of the Northern Rubber Company's staff on their annual outing.

This event caused considerable excitement among the locomotive enthusiasts of Buckinghamshire, Berkshire, Middlesex and Surrey, who collected together in parties at certain vantage-points along the High Wycombe-Maidenhead branch to watch the train go by.

Five hours later, the same engine and train, with the same complement of passengers, ran from Windsor to Canonbury (London) by way of the Western Region main line and the old North London Railway. On this run, the sudden and unannounced appearance of the *ex*-G.C.R. engine and train had an immediate and amusing effect upon those familiar little groups of train-spotters who congregate at railway stations and other lineside locations, especially on Saturday afternoons. On this occasion, the effect seemed to be that most of the spotters temporarily lost their reason by the shock, while it is safe to assume that many of them decided that they had made the " cop of the season," were blissfully happy thereat and will talk about it for months to come !

And when we come to think of it, only a railway locomotive *could* create such a stir ! The reasons for the commotion on June 6th were, first, it is thought that never before had a " Director "-class engine passed over the branch line from High Wycombe to Maidenhead, and secondly, had certainly never gone from Windsor to London, or any other place, over the old Great Western main line. The hero of the occasion was No. 62666, *Zeebrugge*.

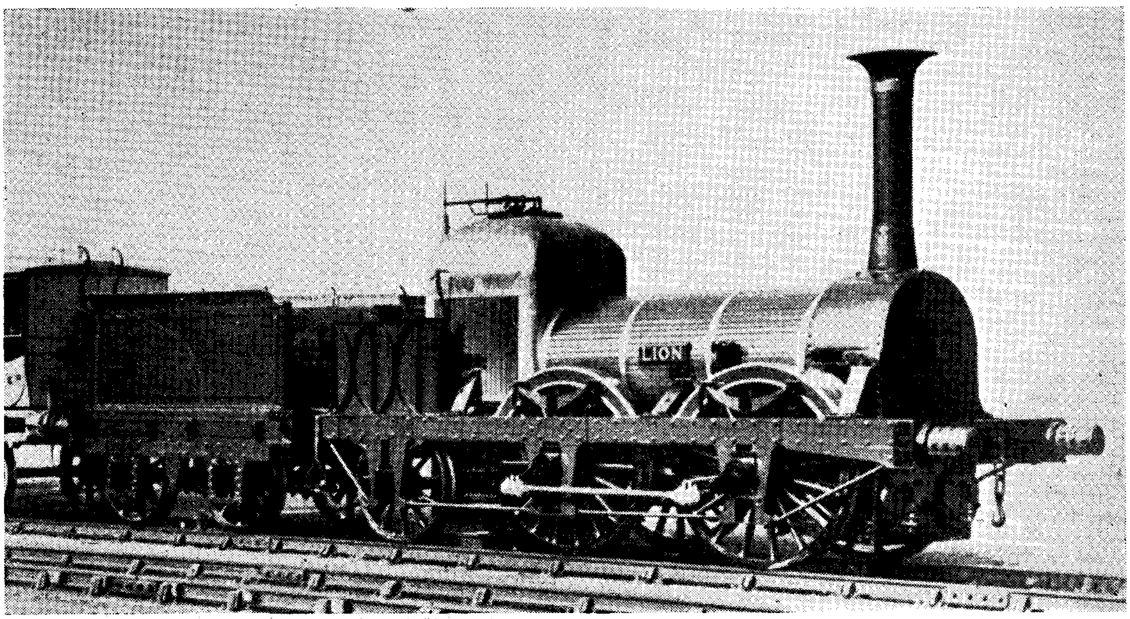
L.B.S.C.'s Titfield Thunderbolt

IN $3\frac{1}{2}$ AND 5 INCH GAUGES

ON this job we are up against the same trouble as with *Invicta*, inasmuch as a " scale " reproduction would be utterly useless for any serious work. Therefore, I have redesigned the layout, to make it simple to build, and satisfactory in operation, whilst retaining the characteristics of the full-sized locomotive. Instead of putting the cylinders in the bottom of the smokebox, a proper inside frame is provided, attached to the lugs on the buffer beam at the front end, and supported at the back end by a motion plate, which also acts as a frame stay. The full-sized engine had an inside frame of sorts, but it was little more than a girder at each side, and only carried the extra axleboxes for the driving axle, which it supported close to the cranks. It did not carry the cylinders, nor any part of the motion direct ; the drawing which Mr. Riddles kindly sent to me, shows the reverse shaft and the rocking-shaft bearings carried by brackets attached either to the back of the cylinder casting, or the back plate of the smokebox.

The way I have arranged matters on the little engine, is shown in the reproduced plan and elevation drawings. The complete inside frame and motion-plate assembly, can be removed bodily, for the erection of cylinders and other oddments. The inside frame plates on the $3\frac{1}{2}$-in. gauge engine, are cut from 13-gauge (3/32 in.) sheet steel, the soft blue kind being most suitable. Those for the 5-in. gauge job are cut from $\frac{1}{8}$ in. steel, the shape being the same in either case. The easiest way to mark out the $3\frac{1}{2}$-in. gauge size, is to take a piece of 13-gauge steel about 8 in. long and $2\frac{1}{2}$ in. deep, and mark on this, the position of the driving axle ; that is, $1\frac{1}{8}$ in. from top edge, and $7\frac{3}{4}$ in. from front end. From this point, draw a line sloping down toward the front, at a 5-deg. angle ; this will cut the front edge of the sheet, at $1\frac{3}{4}$ in. from the top. This will be the centre-line of motion, and the location of cylinders, and position of bolt holes, can easily be set out from it, as shown on the drawing. The length of the cylinder block is $1\frac{3}{4}$ in. and the position is clearly shown by the dotted lines.

The front edge of the inside frame slopes down to the bottom, at right angles to the centre-line of motion ; but behind the cylinders, it rises vertically, and then continues quite horizontal, till it reaches the motion plate. I have dotted in the outline of the outside frames, so that builders can see the relation of the two frames; it makes the job easier ! Note the recess at the point where the vertical and horizontal lines meet ; this is rounded off to clear the leading axle. The No. 30 hole drilled just behind this point is to locate the centres of the bearings for the rocking-shaft which transmits the movement of the eccentric rods to the valve spindles. These bearings will be supported by brackets hung from a stay at the top of the frames, when we get that far. The horizontal part of the frame is high enough to show the guide bars, and allow the crosshead pins to be fitted easily. It also provides clearance for the drive for the crosshead pump. Drill six No. 30 holes for the cylinder-fixing screws, in the position shown, for



The " six-foot " side—note cylinders

the $3\frac{1}{2}$-in. gauge engine, and No. 12 holes, for $\frac{3}{16}$-in. screws, for the 5-in. gauger, in approximately the same position.

The two frames are cut out in the same way as usually described for main plate frames, being temporarily riveted together and sawn, filed to shape, and drilled before parting. Pieces of angle as shown, are riveted to the back ends, on the inside, for attachment to the motion plate. Note :—the holes at the front, for the fixing bolts, are located from those already in the distance-pieces when erecting, as the bolts go clean through the lot ; see plan view.

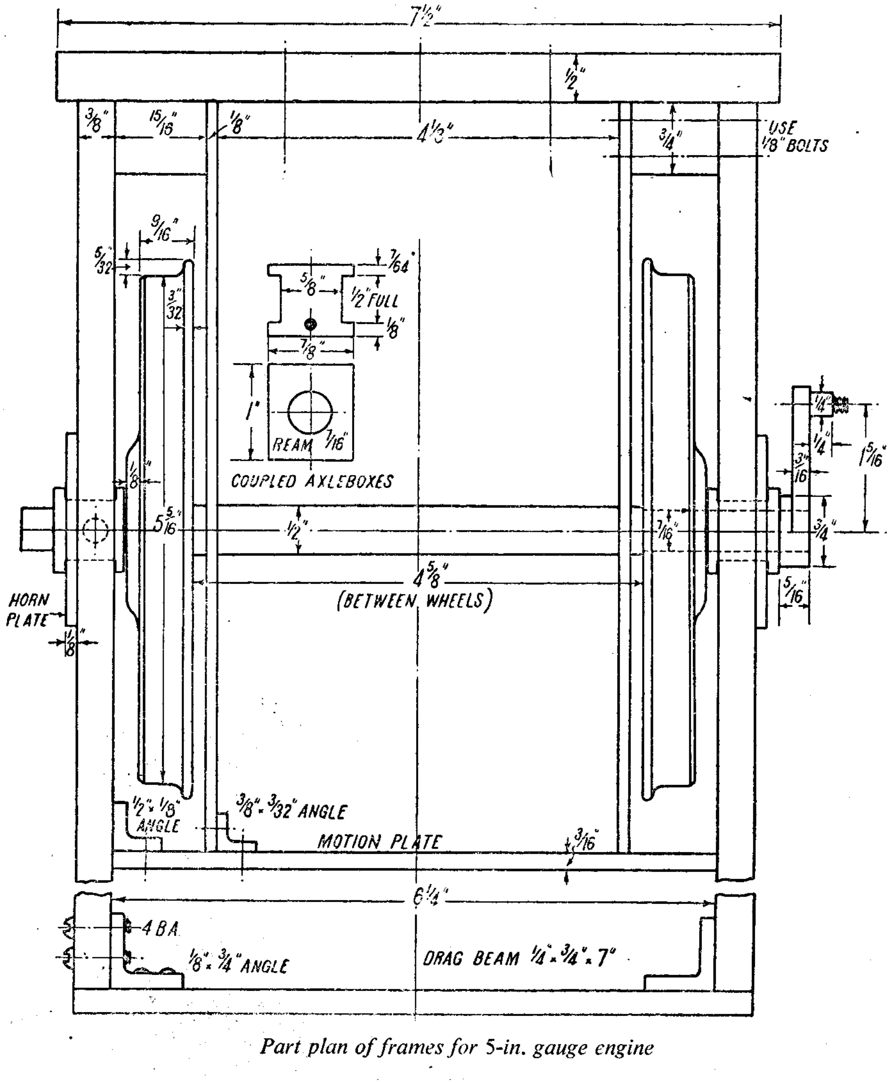
Motion Plate

This will be the next job, as we can't erect the inside frames without it. On the $3\frac{1}{2}$-in. gauge engine, it is cut from $\frac{1}{8}$ in. steel plate ; use $\frac{3}{16}$ in. for the 5-in. job. It is quite possible that our approved advertisers will supply castings with the lugs for attachment to both frames, cast integral. If they don't, it is a simple matter to rivet on pieces of angle as shown. When making the motion plate, be sure to locate the small holes alongside the oval clearance holes for connecting-rods, exactly as shown. These holes are for the spigots at the ends of the blocks supporting the guide bars ; and if they are out, the crossheads will bind. To avoid any chance of error when setting out the motion plate for the 5-in. gauge engine, I have shown a separate half-elevation of it, fully dimensioned ; and the position of the angles for attachment to both inside and outside frames, is shown in the plan of the larger front end.

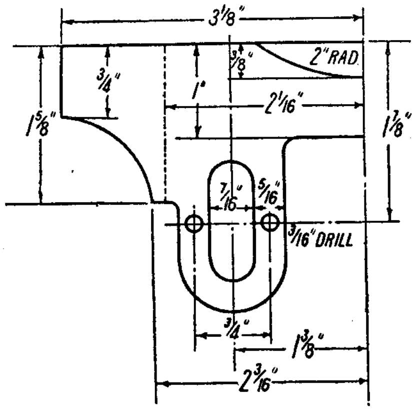
When the motion plate is completed, rivet the angles on the ends of the inside frames to it in the location shown, so that the latter will be at the proper distance apart ; that is, $2\frac{13}{16}$ in. for the $3\frac{1}{2}$-in. gauge engine, and $4\frac{1}{8}$ in. for the 5-in. After riveting the first one, lay the assembly upside down on the lathe bed, or something equally flat and true, and see that the tops of both inside frames are in contact with the flat surface. Then temporarily clamp angle to frame, and rivet up. The assembly can then be put between main frames, and bolted right up through at the front end as shown ; but you needn't tighten up too much, as the whole bag of tricks has to come out for erecting the cylinders. The angles at the back end are attached to the outside frames as shown, by roundhead screws with nuts inside. The hexagon-headed fraternity takes a back seat here, because the excellent photograph sent by Mr. Riddles, doesn't show a single blessed hexagon nut along the whole length of the frame ! The pimples are not very numerous, either. Use 5/32-in. or 3-B.A. screws for this job on the 5-in. gauge engine. This way of erecting the inside frames renders them easily detachable.

5-in. Gauge Frame Assembly

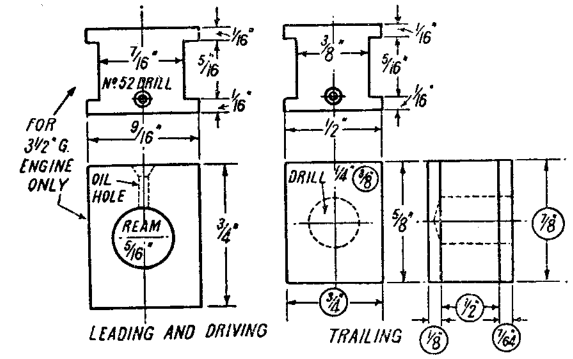
As promised, here is the separate plan drawing of the 5-in. gauge frames assembled. It gives all the measurements required, also diameter and width of the coupled wheels, and details of the coupled axleboxes. All dimensions are "Curly standard." The whole construction is the same as for the $3\frac{1}{2}$-in. engine, the distance-piece blocks being brazed to the buffer beam, if castings are not used, and the whole lot is built up. If castings are used, however, be mighty careful



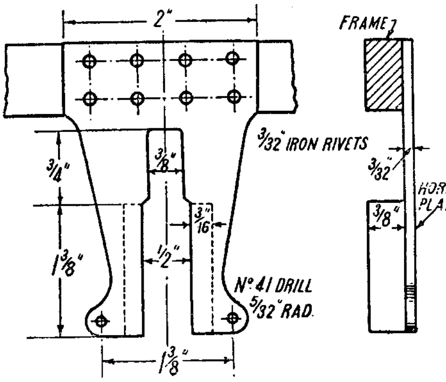
Part plan of frames for 5-in. gauge engine



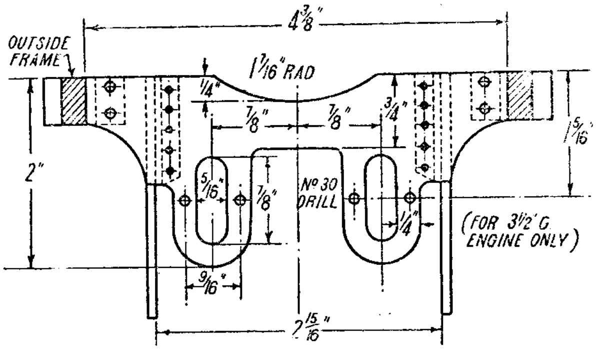
Motion-plate—5-in. gauge engine



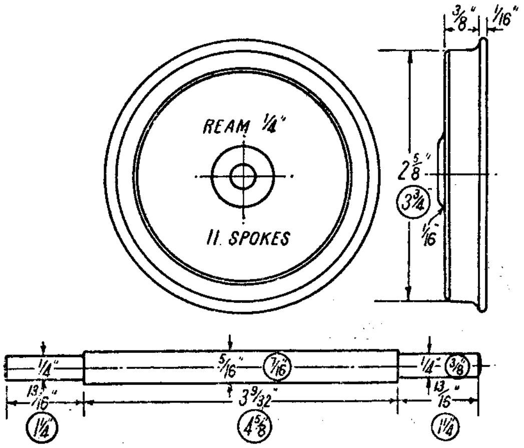
Axleboxes



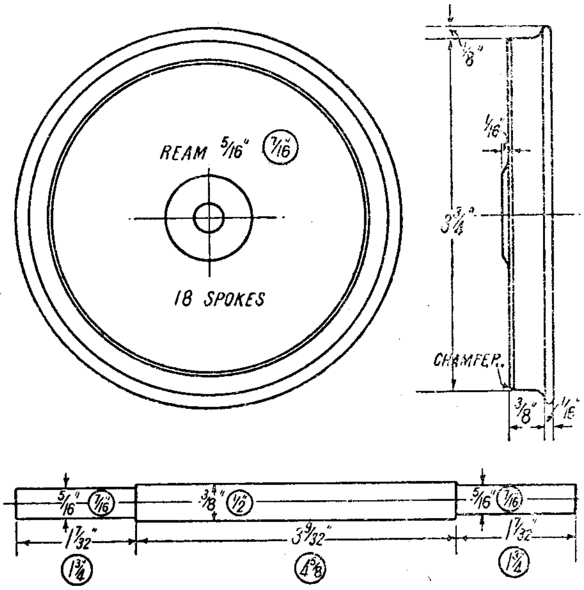
Trailing hornplate—5-in. gauge engine



Back of motion plate for 3½-gauge engine



Trailing wheel and axle



Right—Coupled wheel and leading axle

to mill or file the sides of the distance-piece lugs square with the beam, and dead parallel, also have them the right thickness, so that the frames line up absolutely O.K. in every way. If they don't, the axles will lie skew-whiff across the frames, and will bind in the axle-boxes.

I have also included a separate drawing of the trailing hornplates for the larger edition of the "Tit." The cheeks may be made from $\frac{3}{16}$ in. × $\frac{3}{8}$ in. steel, brazed edge-on at each side of the opening, and the whole issue riveted to the outside frames, as on the smaller engine.

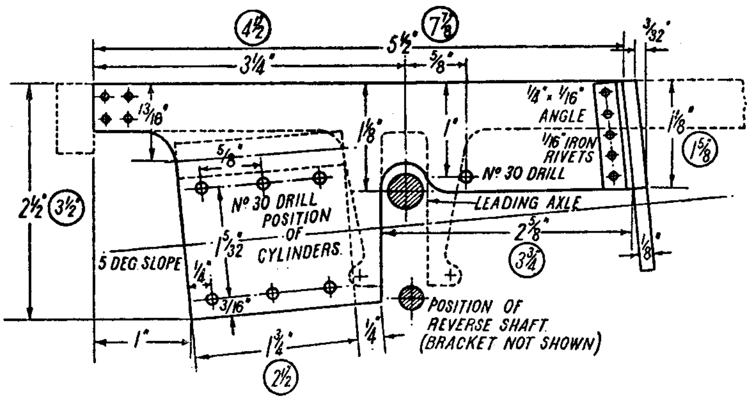
Wheels and Straight Axles

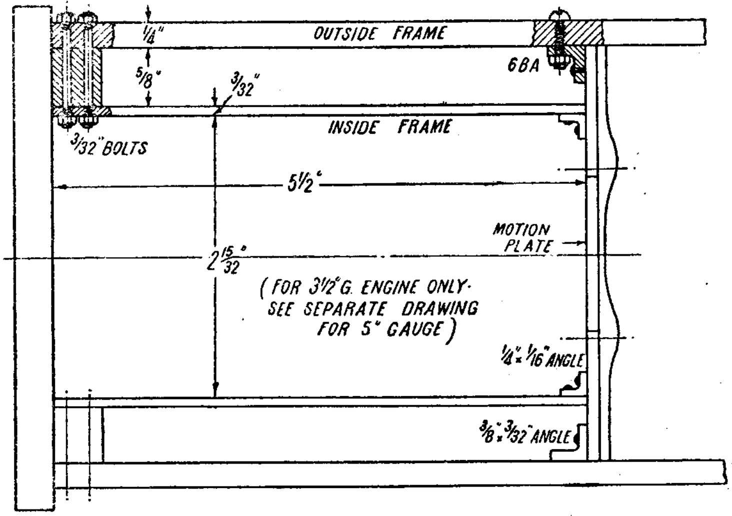
All wheel dimensions are given in the drawing; and as the machining is exactly the same as for all the other engines described in these serials, there is no need to use twenty words where one is sufficient! My procedure, briefly, is to chuck by tread, face back, bore, ream, and rough-turn flange; reverse in chuck, hold by flange, and turn face and boss; mount on stub mandrel fitted in improvised faceplate held in chuck (an old wheel casting does fine for this) securing by a nut on end of stub mandrel. Rough-turn treads to within about 1/64 in. of finished size, then take a final cut off each, with freshly ground tool, without shifting the cross-slide for the particular size of wheel. All coupled wheels will then be exactly the same diameter, and the carrying wheels on opposite sides of the locomotive will be ditto, reducing tread and flange wear, and making for easy running. Slipping is reduced to a minimum on curves, and is *non est* on the straight run. The edges of the flanges can be rounded off with a file, before removing the finished wheel from the stub mandrel.

By the way, beginners and new readers often call me over the coals for referring to back notes, previous descriptions, etc., saying that they don't possess any back numbers so what about it. Well, the trouble is, that if I detailed out the whole ritual in full for every locomotive described in these serials, the notes would just become a mass of dreary repetition, and (I better whisper this in your ear!) I like to try to give value for what the firm pays me, as well as playing the straight game with regular followers of the "words and music." So here is a tip for the no-back-number merchants. The book about *Maisie*, which can be obtained from our Publishing Dept., contains the full description of the building of a 3½-in. gauge locomotive from A to Z. All processes, turning, machining, fitting, boiler-smithing, sheet-metal working, making of fittings and so on, are set out in detail, and in most cases are illustrated; and as these operations are common to any kind of locomotive, whatever the type, they are applicable to the jobs which beginners and new readers often write to me about. A nod is as good as a wink to a blind horse!

The axles are turned from mild-steel; if your chuck is not too Ananiaslike, rod of the given axle dimensions can be used, as wheel seats and journals are turned at the same setting, and therefore must be true with each other. Any slight eccentricity of the middle part between the wheels, doesn't matter, and it is out of sight of Inspector Meticulous, anyhow. If the chuck is too wibbly-wobbly, use steel of a shade larger diameter than the finished axles, and turn them between centres. The actual job is one of the first regular steps in the art of metal turning, just a practice job for an intelligent kiddy, so we needn't dilate on that; but as the turned part forms journals outside of the wheel seats, aim for the smoothest possible finish. I use a knife tool with the sharp tip slightly oilstoned, and plenty of cutting oil (equal parts "Cutmax" and paraffin and never have any trouble.

(Continued on page 8)



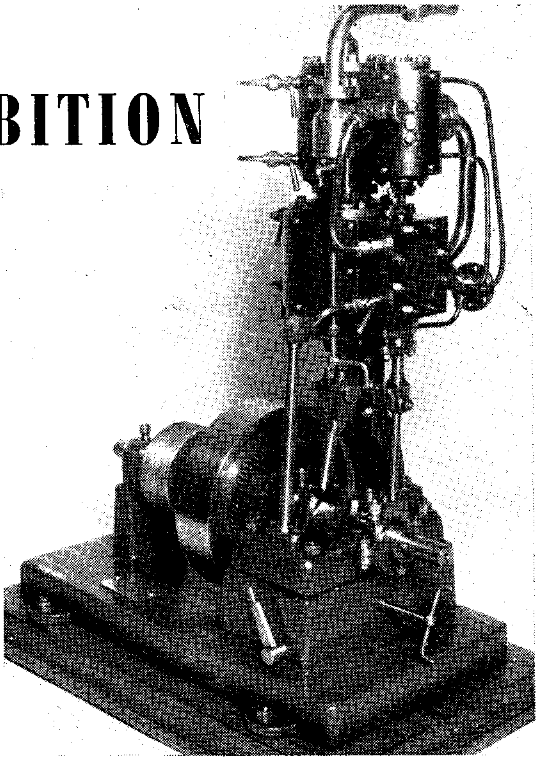


Arrangement of inside frames

Steam Engines at the

BIRMINGHAM EXHIBITION

Described by "NORTHERNER"

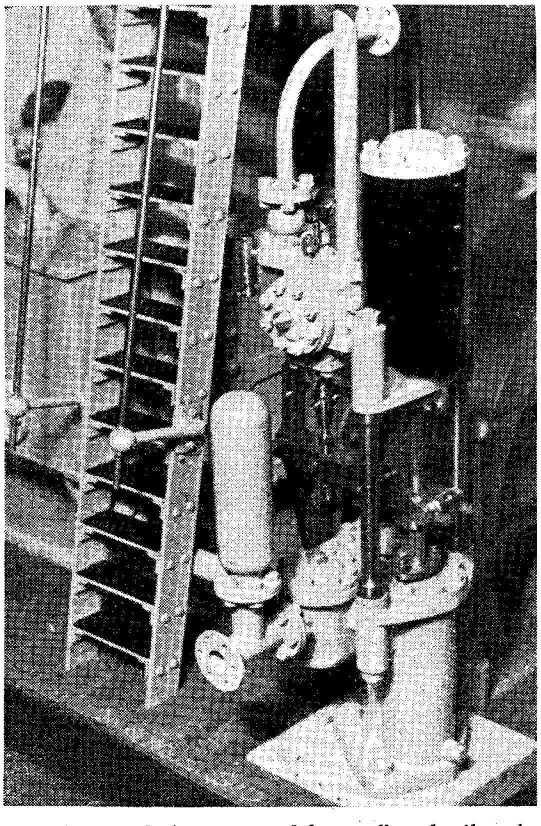


A well-built tandem compound marine engine built by C. T. J. Nichols, of the Cheltenham club

A LARGE number of steam engines were a feature of this year's Birmingham Exhibition, among them quite a few old friends, such as five of the engines built by F. Smith, of Pinxton.

An engine I had not seen before, however, was a very fine vertical condensing mill-engine built by G. W. Chittock. The prototype was built by Worth and Mackenzie, of Stockton-on-Tees, and worked for nearly fifty years at the carpet factory of Worth and Sons, Stourport-on-Severn, before being dismantled in 1928. Before this took place, Mr. Chittock decided that the engine should be perpetuated in model form, and made several drawings, from which the present inch-scale model has been made.

The builder has naturally incorporated all the detail that was on the original, and the Weir pump is worthy of exhibition on its own. The engine is beautifully made throughout ; most of the parts are fabricated, being built up in steel, pinned and brazed, with very neat results in such parts as the governor stand, condenser, and so on. In fact, the cylinder and the flywheel are the only two castings used.



This photograph shows some of the excellent detail work, including the Weir pump, of G. W. Chittock's lovely mill-engine

Expansion valve-gear is fitted, the travel of the expansion-valve being controlled by a slotted curved link which, in turn, is controlled by the very pretty governor. The big-end is slotted, with split brasses and screw-wedge adjustment, and is fitted with a grease-cup, as are the eccentrics and the main bearings.

As mentioned, a condenser is fitted, being " built in " to the main standard of the engine ; the air-pump is driven from the cross-head. The fittings include an exceedingly neat stop-valve, and a very nice ladder, with overhead foot-plating and handrails—there is even a miniature oil-bottle on the footplate. The paintwork is very good, too, in a mid-grey.

I am told that Mr. Chittock is now building a portable engine. If this is up to the mill-engine standard—and one cannot imagine otherwise—I look forward to seeing it at some future time.

Marine Engines

There were several marine-type compound engines, and a couple of triple-expansions, but I have only space to notice three of the former.

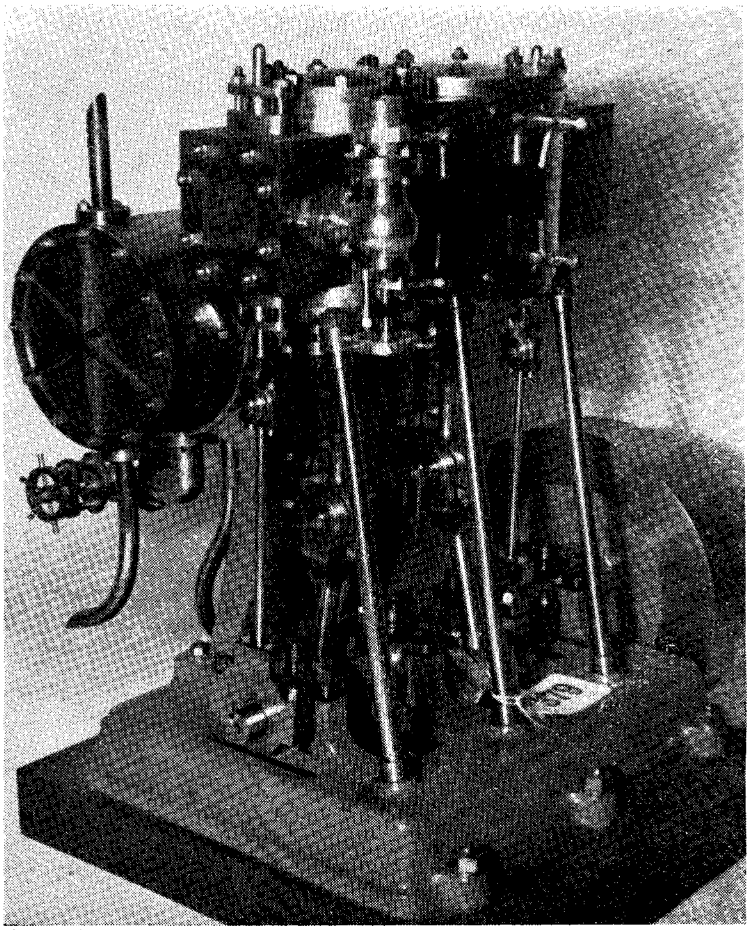
The first of these was of a type which does not seem to be modelled very often, with the cylinders in tandem. It was built by C. T. J. Nichols, of Cheltenham, and was well-made and painted. For much of the time it was running on the compressed air stand, and working quite happily too,

in spite of the non-expansive properties of that particular working fluid.

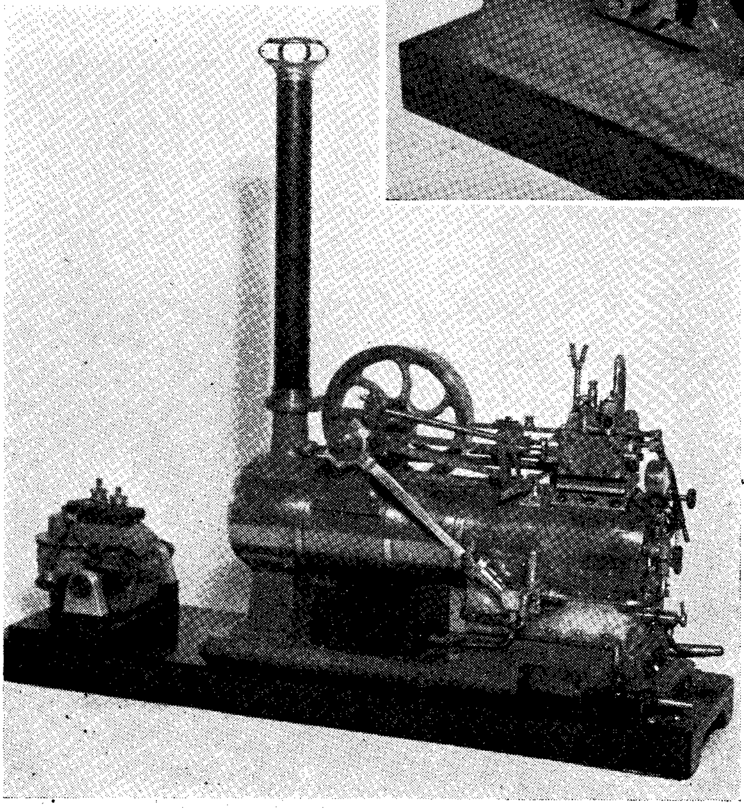
A piston-valve was fitted to the high-pressure cylinder, and slide-valve to the low-pressure—this was, of course, quite common practice in compound marine engines. Details noticed included small pipes carried from the draincocks to the exhaust-pipe—again good prototype practice—and a neat cock fitted to drain the soleplate. Hand-turning gear was fitted, with a handled shaft passing through the bedplate. On the end of this was a pinion, and when the shaft was slid forward, this engaged with a spur-wheel bolted to the inner face of the flywheel.

Another marine-engine was built by A. E. Phillips of Birmingham, whose excellent Fowler traction-engine was mentioned and illustrated in the preliminary report of this show. The compound-engine bore a plate dated 1907, so it has evidently had a long life, despite which it still ran beautifully on compressed air.

It was of more or less orthodox design, and was coupled to a 2 to 6-volt dynamo, which appeared to be



Another compound marine engine, but this time with condenser and air-pump, by J. V. Kidger, of Redditch



Left—F. W. Wallis's overtype engine was described in the author's preliminary article

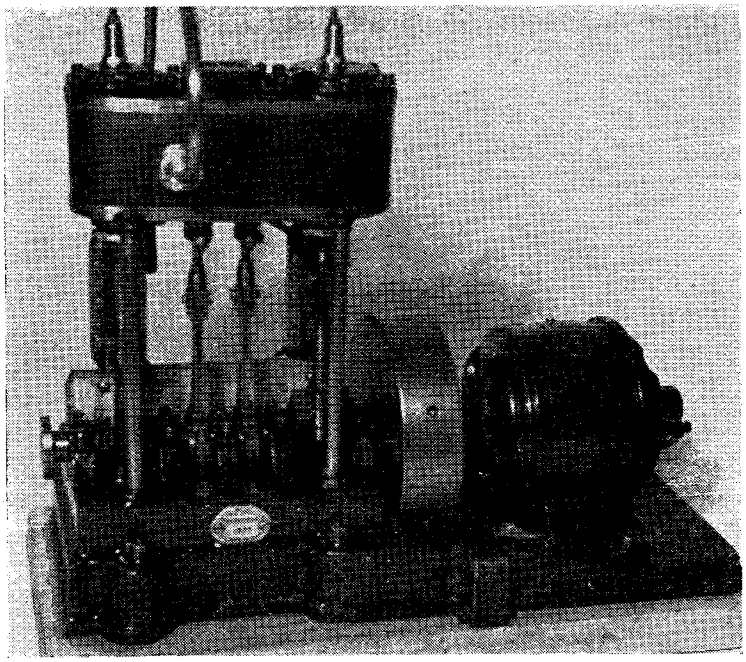
of commercial manufacture. Ova glands were fitted, instead of the screw-in type so frequently found on small model marine engines, and the crossheads were split to take the gudgeon-pins. Another nice point was that the valve cross-head pins were secured by fine taper pins.

A third compound engine was that built by J. V. Kidger, of the Redditch club. This was a more massive job than the last mentioned, and was fitted with a condenser. Incidentally, I would have preferred to see both the latter and the copper cylinder

lagging painted, instead of being left bright, which was not in keeping with the prototype. The bedplate *was* nicely painted, and the finish on the bright parts was good too.

The air-pump was mounted below the condenser, and driven by rocking levers from the low-pressure crosshead. Very nicely-made twin links connected the levers to the crosshead, and also to the crosshead of the air-pump. Split brasses were fitted to all bearings, and the two globe stop-valves were well made.

Finally, I am including a photograph of the handsome overtype engine and generator built by F. W. Wallis of Birmingham, which, it will be recalled, was described in my opening article.



This compound marine engine coupled to a dynamo was exhibited by A. E. Phillips, of Birmingham

L.B.S.C's Titfield Thunderbolt

(*Continued from page* 5)

The axles must be a press fit in the wheel bosses but not tight enough to split them. Cast-iron sometimes splits very easily. In previous notes, when dealing with locomotives having inside frames, I usually recommend easing the axle ends with a fine file to give them a start in the wheel boss ; but as the bearings are outside the wheels, in the present case, and should be smooth, parallel, and a proper fit in the axleboxes, it would be better to turn the wheel seats and journal section to correct size, as shown, and very slightly ease the hole in the wheel boss with a broach, to give it a start. Maybe it will be asked why I don't specify the journals to be of slightly smaller diameter than the wheel seat, as is usual practice. Well, there is method in my madness, as usual. When the wheel is pressed over the journal part, it leaves a kind of glazed surface that reduces both friction and wear ; and in addition, the diameters of the journals are small enough in all conscience, as it is, without reducing them further. Of course, there is nothing to prevent anybody who so desires, from using different diameters, and drilling their axleboxes to suit.

As there are neither balance weights nor crankpins in the wheels, they may be pressed straight on to the axles, using the vice as a press. Their position on the axles in relation to each other, doesn't matter a bean. All you want to worry about is that the distance between wheel backs is exactly as shown in the illustrations, and that the wheels run truly on the axles, without any trace of wobble. I hope to describe the crank axles and eccentrics in the next instalment.

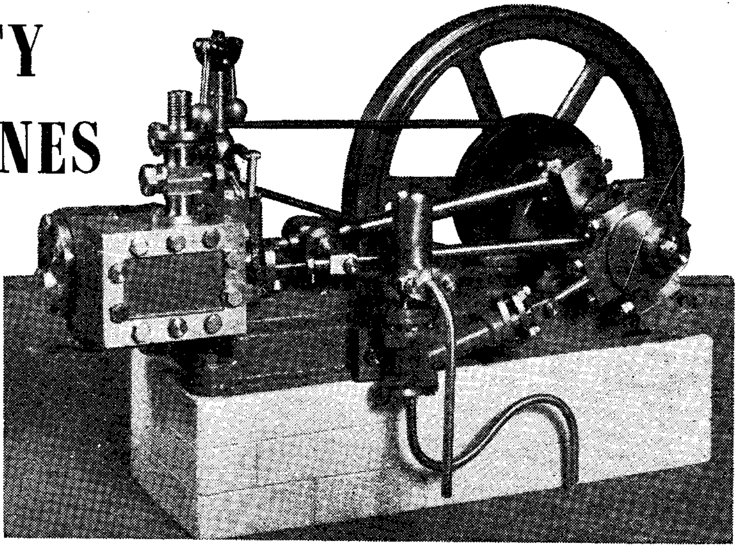
Axleboxes

Our approved advertisers will probably supply the axleboxes cast in a stick ; but ordinary cast or drawn bar can be used. It should be good quality bronze or gunmetal. The easiest way to machine the grooves, is to do the lot at one shot, before parting or sawing the boxes off the bar. If a regular milling machine isn't available, use the lathe, clamping the bar under the slide-rest tool holder, at correct height, and using an endmill or slot-drill held in three-jaw. If the boxes are sawn from the bar, face off the ends to length in the four-jaw. Note that the inner flanges on the 5-in. gauge engine, are thinner than those on the outside, to give the axle freedom. Fit the boxes to the horns, and mark them, so that they can always be replaced as fitted ; then mark centres of boxes on one side of frames, drill No. 30, and use them as jigs to drill their opposite mates on the other side. Test for parallelism by putting the boxes in place, and putting a piece of $\frac{1}{8}$ in. silver-steel rod through ; this is usually straight enough. If it doesn't lie parallel across the frames, ease the holes with a file, to bring them right, drill No. 12, and try again with a bit of $\frac{3}{16}$ in. steel. When the test rod lies parallel, open out the holes in the boxes to correct diameter, by drilling first with a drill about 1/64 in. less than finished size, and finishing by putting the reamer through whilst the boxes are in place in the horns.

The above jobs should keep "Tit" builders busy whilst your humble servant gets out some drawings for the old-fashioned cranks, coupling-rods and other relics of the really good old days.

MORE UTILITY STEAM ENGINES

By Edgar T. Westbury



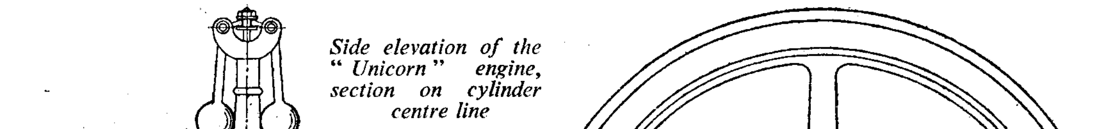
The " Unicorn " ¾ in. × 1¼ in. horizontal mill engine

MY series of articles on " Utility Steam Engines," published in THE MODEL ENGINEER during 1949 and 1950, had a very good reception —much better than I had expected, possibly better than it really deserved. The object of the series was a very modest one, as it was intended merely to help readers in the selection of basically simple power plants for " utility " purposes, capable of doing their job reliably and efficiently within their limitations. I did not venture to go very deeply into either the theory or practical design of steam engines, or to attempt anything ambitious in the modelling of prototypes, as I feel that there are very many readers of THE MODEL ENGINEER, who are much more qualified than myself to undertake this—if they would only come forward.

My mission, such as it was, to promote the construction of " workaday " engines, seems to have borne good fruit, and several of the engines described in the series have been constructed by readers, apparently to their satisfaction. A number of " Warrior " twin engines are doing yeoman service in prototype boats; testimonials to the success of the sturdy little " Trojan " single have been received from as far afield as the U.S.A. and Australia; and the " Spartan " has been seen in several experimental fast cruising boats, in both poppet- and piston-valve versions.

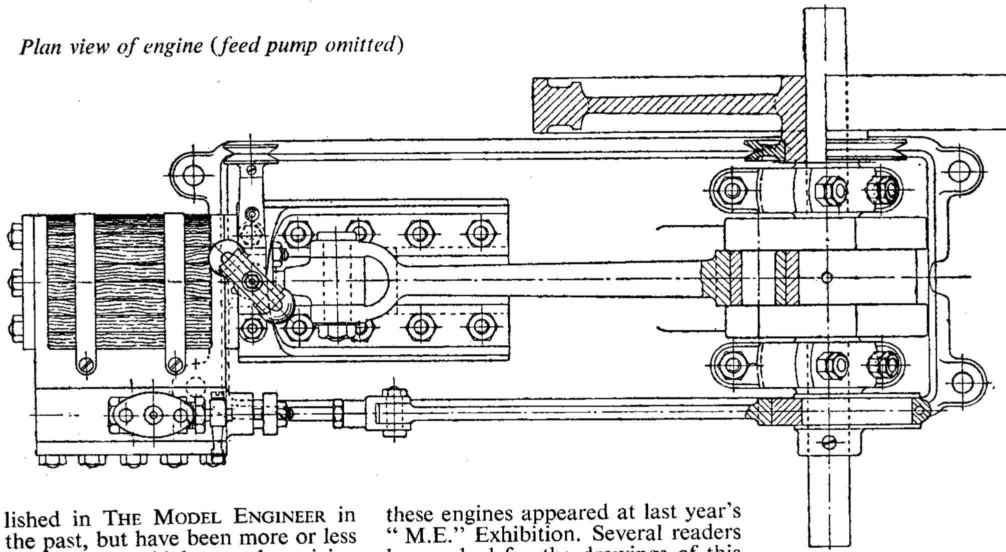
Ever since this series was published, I have received requests from readers for further articles of a similar nature, and the opinions expressed suggest that the scope of the "utility" engine is wider than I had visualised. It may be remembered that I went to some pains to give an exact definition of the term " utility," and my application of it to the subject in question; but it has been suggested that it has a much wider interpretation. For instance, several readers have asked for a design for a horizontal engine, pointing out that engines of this type are always popular when shown running at club meetings and exhibitions; in this respect, they may be regarded as capable of working for their living, even if they are not used to drive anything. There are, of course, many good designs for mill engines in existence, but many of them are somewhat unimaginative in design, and a few are not too scrupulous in fidelity to detail. It may be observed that this type of engine, once the most popular among beginners, and constructors who favour the less elaborate types of models, has been much less in evidence in recent years, and it is possible that one reason for this may lie in the lack of variety in designs now available.

It has been put to me that some of the designs which have been pub-



Side elevation of the " Unicorn " engine, section on cylinder centre line

Plan view of engine (feed pump omitted)

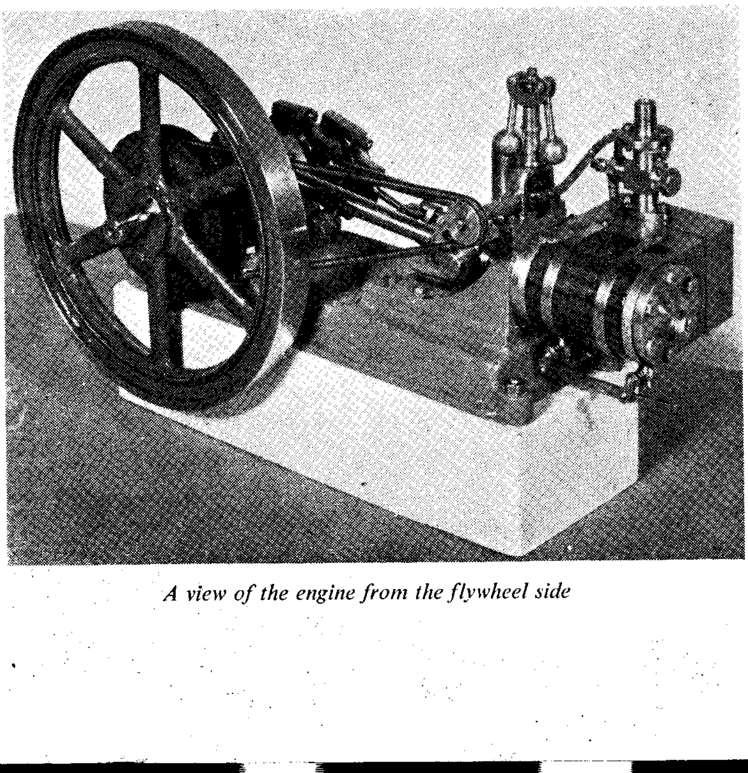


lished in THE MODEL ENGINEER in the past, but have been more or less forgotten, would be worth reviving for the benefit of new readers. This opinion has often been expressed by readers, many of whom have asked for reprints of past articles and designs. On the whole, it is not a good policy to reprint articles in this journal, as it may give some readers the impression that there is a shortage of new material or ideas, which is by no means the case; but I heartily agree that some of the classic designs of the past deserve to be remembered. Instead of reprinting them *en bloc*, however, I suggest that their construction might be dealt with in entirely new articles, conforming with modern methods of machining the components. If my readers agree, one of the designs I propose to treat in this way is the Tangye twin horizontal mill engine, castings for which were once obtainable from the Liverpool Castings & Tool Supply Co., a firm now unfortunately defunct, but once very highly regarded for the excellence of both designs and material for model construction.

Some readers have gone so far as to include beam engines and other early types in the " utility " category, and have so impressed me that I have started investigating these possibilities, though I have not had time to go beyond the drawing-board stage up to the present. There appears to be quite a good deal of scope for the revival of some early engines, which have been overlooked by model engineers in the past. Of course, the classic model in this class is the " M.E." beam engine, described by Mr. George Gentry as far back as 1914, but still popular, as proved by the fact that two of these engines appeared at last year's " M.E." Exhibition. Several readers have asked for the drawings of this engine to be reprinted.

Some readers have suggested that I ought to devote more attention to ultra-simple steam plants, with special reference to the oscillating type of engine. In my previous articles I gave definite reasons why I had not included a design for an oscillating engine, and my views on this matter have not changed; moreover, there have been some good articles on engines of this type published in THE MODEL ENGINEER within the last year or two. I would assure readers that I have no " prejudice " against this or any other type of engine, and I have built quite a few of them in my time, including some with detail improvements; I am prepared to put a design in print if it is a matter of general interest.

Apart from the possible revival of early published designs, or simple adaptations, it is necessary to carry out a fairly considerable amount of practical work in order to produce really useful material. Clever designs are not good enough unless they are backed up by practice, and there are always minor snags which have to



A view of the engine from the flywheel side

be "ironed out"; very few new designs "get by" straight off the drawing board. There are, of course, limits to the number of finished engines one can produce in a given period of spare-time work, and it is physically impossible for me to complete every engine I describe on paper. Since my previous articles were published, I have only been able to build one steam engine, and in accordance with the views of readers, this is of the horizontal stationary type, or in other words, a "mill engine." I use this term with some misgivings, as it has been used only too often to cover a multitude of sins. While there have been some excellent examples of mill engines produced both by individuals and trade firms, the name has often been applied to anything with a cylinder, a crank, a flywheel and a crosshead, often grossly out of proportion and resembling nothing that ever was perpetrated by any self-respecting engineer in full size practice. While my version of this type is certainly not above criticism, I sincerely hope that it has succeeded in eliminating the worst crimes in design.

The "Unicorn" Mill Engine

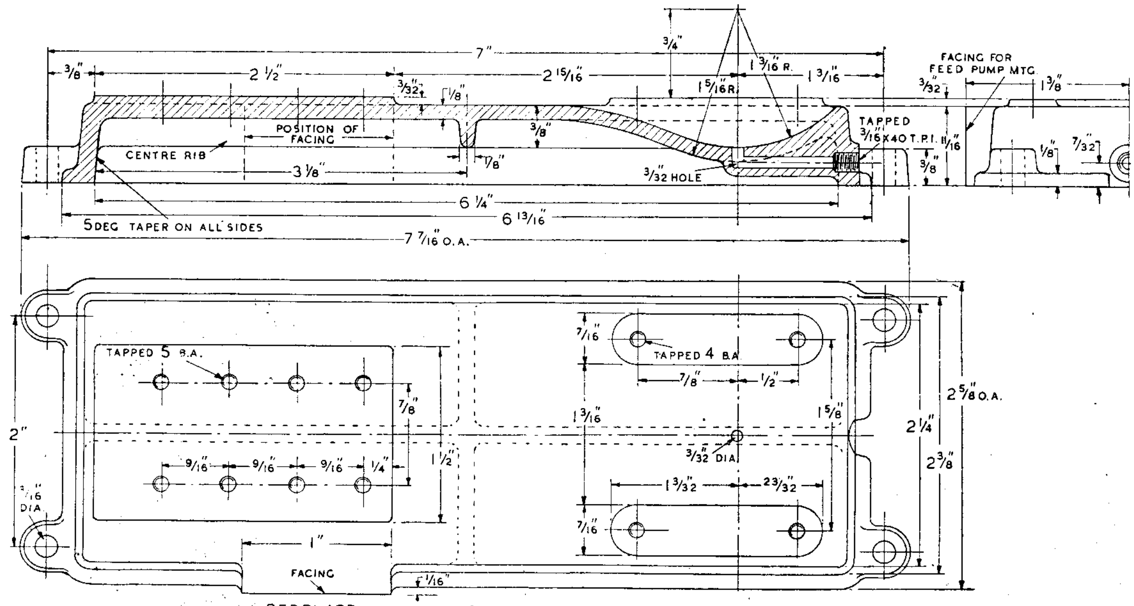
No special claims for originality or ingenuity are made for the design of this engine; its main object is to provide something reasonably simple yet interesting to construct, and at the same time realistic and correct in character. It is a "free-lance" design, in the sense that it is not a copy of any particular full-size engine, but it is based on an old engine which was discovered in a derelict mill, and had already been partially mutilated by the vandal hand of the scrap merchant. Some of the details, therefore, were missing and had to be reconstructed, not by guesswork, but by reference to such information as could be obtained about engines of the period, which is presumed to be between 1880 and 1900. The model has been made to about $1\frac{1}{2}$-in. scale, and proportions have been adhered to as closely as possible, compatible with convenience in machining and fitting the smaller parts.

Where the engine differs from many others of its type is in the method of mounting the cylinder, the design of the crosshead and slipper-guide, and the bearing pedestals, these components being made to conform, in appearance at least, to the prototype, though not in the methods adopted for construction. The flywheel has been meticulously copied, including the distinctive rim section, and also the governor design, though the action of the latter has been modified. For the benefit of readers who are interested in "whys and wherefores," I shall try to give the reasons for the particular methods adopted in the construction of the various components, and explain what modifications or departures from prototype design are considered permissible without destroying general fidelity or realism.

Bedplate

This is designed in such a way as to require the minimum of machining, and in fact it would be possible to dispense with machining altogether in cases where facilities are not readily available. In many of the older types of engines, the bedplates were too large to machine on the machines then in existence, and the surfaces which were required to be true were dealt with by chisel and file. As a result, designers practised a rigid economy in the area of such surfaces, and kept them small and narrow wherever possible; the term "chipping strips" still survives in modern practice, even though these surfaces are almost invariably planed or milled.

In a model, there is not the same incentive to restrict the area of truly plane surfaces, but it is an obvious advantage to arrange them so that they can be conveniently dealt with by hand or machine, and also, wherever possible, to keep them all at one level. Although some model engineers possess planing or shaping machines, the majority of us are obliged to carry out major surfacing operations in the lathe, and the latter consideration becomes of



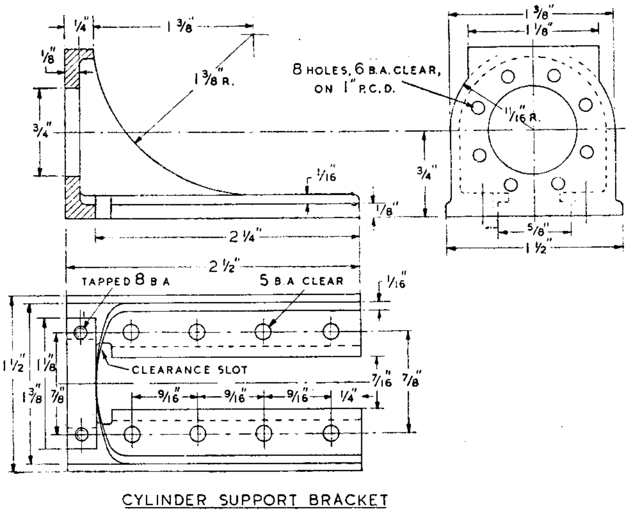
BEDPLATE 1 OFF C.I. OR L.A.

paramount importance. I have had to tackle bedplates where the cylinder platform, and seatings for bearings and slide-bars, were all at different levels, and as these affected alignments, measurements were critical and difficult to check.

The bedplate shown can be clamped to the lathe faceplate, and a cut taken across all three of the raised surfaces. It has been arranged to swing comfortably in a 3½-in. gap bed lathe, using a 9 in. faceplate, and a couple of clamping plates which will bridge the two mounting lugs at each end of the casting. A smaller faceplate could be used if four special "dogs" are made to grip the sides of the casting; when this method is employed, the effect of the tapered sides will help to keep the work pressed firmly against the faceplate. The rim on the underside of the casting does not need to be machined, but it should be filed to eliminate any unevenness, so that when tested on a surface plate, or other truly flat surface, it bears evenly with no tendency to rock.

With reasonable care in machining, the surfaces should be accurate enough for all practical purposes, but they may with advantage be checked afterwards on a surface-plate, using "mechanics' blue" or other marking colour, and any slight errors dealt with by scraping. The only other work on the bedplate consists of drilling and tapping holes for the fixing of components, the location of which can be "spotted" when the latter are ready, also the drilling and spot facing of the holes in the lugs, and the drain passage under the crankpit.

Incidentally, the "correct" material for the bedplate is obviously cast-iron, but I have specified light alloy (usually referred to as "allie" in the workshop) as a substitute. This will probably horrify some of the critics, to whom the use of aluminium in any form in a model steam engine appears to be an unforgivable sin. I have never understood why this should be so, when other metals which are hardly ever seen in full-size practice are condoned. It is true that aluminium is an anachronism, when applied to models of old engines where the utmost fidelity is called for; but it is a highly suitable structural material and simplifies machining, and its colour, though not the same as iron or steel, resembles it more closely than does brass or gunmetal. But I would make it clear that I do not recommend this, or any other substitute metal, for any important component having a bright finish, as it would be much too conspicuous for realism. In the present case, the bedplate and other parts where light alloy is permitted, are finished by painting practically all over their visible surfaces, and any part not painted is invisible or unobtrusive.



CYLINDER SUPPORT BRACKET
1 OFF C.I OR L.A

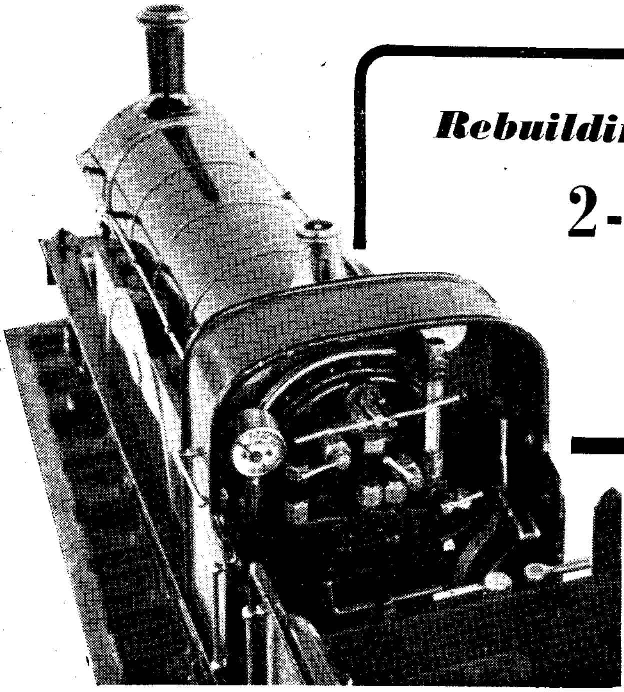
Cylinder Support Bracket

This feature is one that is rarely seen on model mill engines, which more usually have the cylinder mounted by bolting down to an extension of the bedplate. Had this method been adopted in the present instance, however, the bedplate would have been too long to machine by the methods described, unless its size or proportions were altered, and this expedient was not considered desirable. The full-size engine had the bracket cast integral with the bedplate, but this again would introduce a difficult machining problem, involving a boring and facing operation on the vertical end face, and also a planing or end milling operation on the slideway, between the webs of the bracket. For this reason, a separate bracket is provided, and the design further modified by incorporating the slide-way keeps in the same casting.

This component also can be made either in cast-iron or light alloy, and to facilitate machining, an extension bridge piece is provided across the open end of the slideway, to be cut away after machining is completed. The casting may in some circumstances be found somewhat tricky to hold for facing the under surface. As the slideway calls for machining by shaping or milling, however, it is a good idea to machine the main under surface in the same way, at the same setting, thereby precluding the risk of any errors in parallelism of the surfaces. The casting may be gripped by the sides in a small machine vice, and the face set true in both planes (i.e., parallel to the base of the vice), for either method of machining. I did the job on the vertical-slide, using an end-mill in the chuck, but a small shaper would be at least equally suitable for the job if available. The flat under surface can then be dealt with, but before machining the slideway, a centre-line should be marked on the base and the bridge piece, also up the vertical face, and all machining operations symmetrically related to this line. When setting the vertical-slide, a scribing block on the lathe bed will enable the line to be set truly horizontal, and level with the lathe axis.

If suitably sized cutters are available, the edges and recess of the keeps may be machined to their full width at this level; it should be noted that an end-mill will usually cut a little oversize, especially if it does not run perfectly truly, but this will not matter, as the slipper can be made to suit. Should it be necessary to raise or lower the slide to obtain the width required, however, care should be taken to keep the cut symmetrical about the centre-line. This can be done by using the index of the vertical-slide feedscrew, if due allowance is made for taking up backlash both ways. The depth of the recess is also important, though errors can be compensated when making the slipper, if necessary.

(To be continued)



Rear view showing arrangement of footplate fittings

Rebuilding a half-inch Scale
2-2-2 LOCOMOTIVE

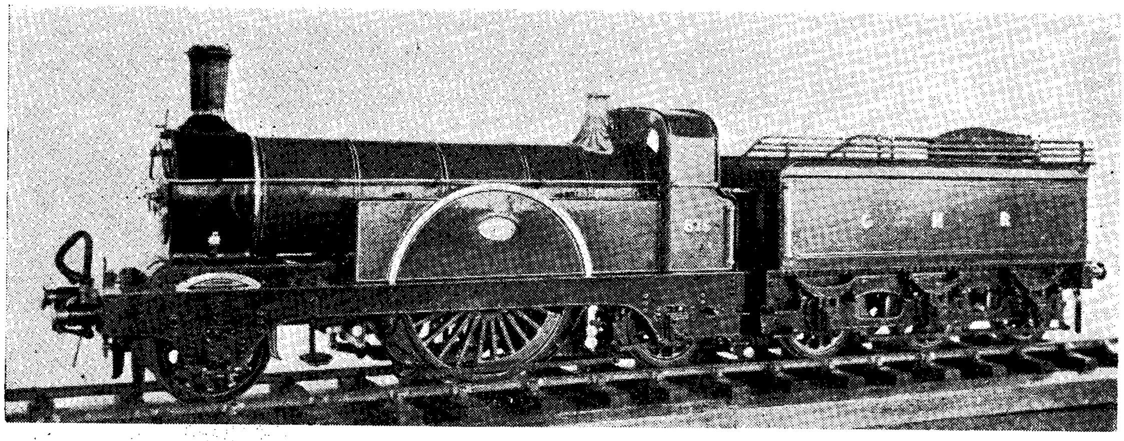
- **This article also includes particulars of the Stirling Six-wheeled Singles of the Great Northern Railway**

By C. M. Keiller

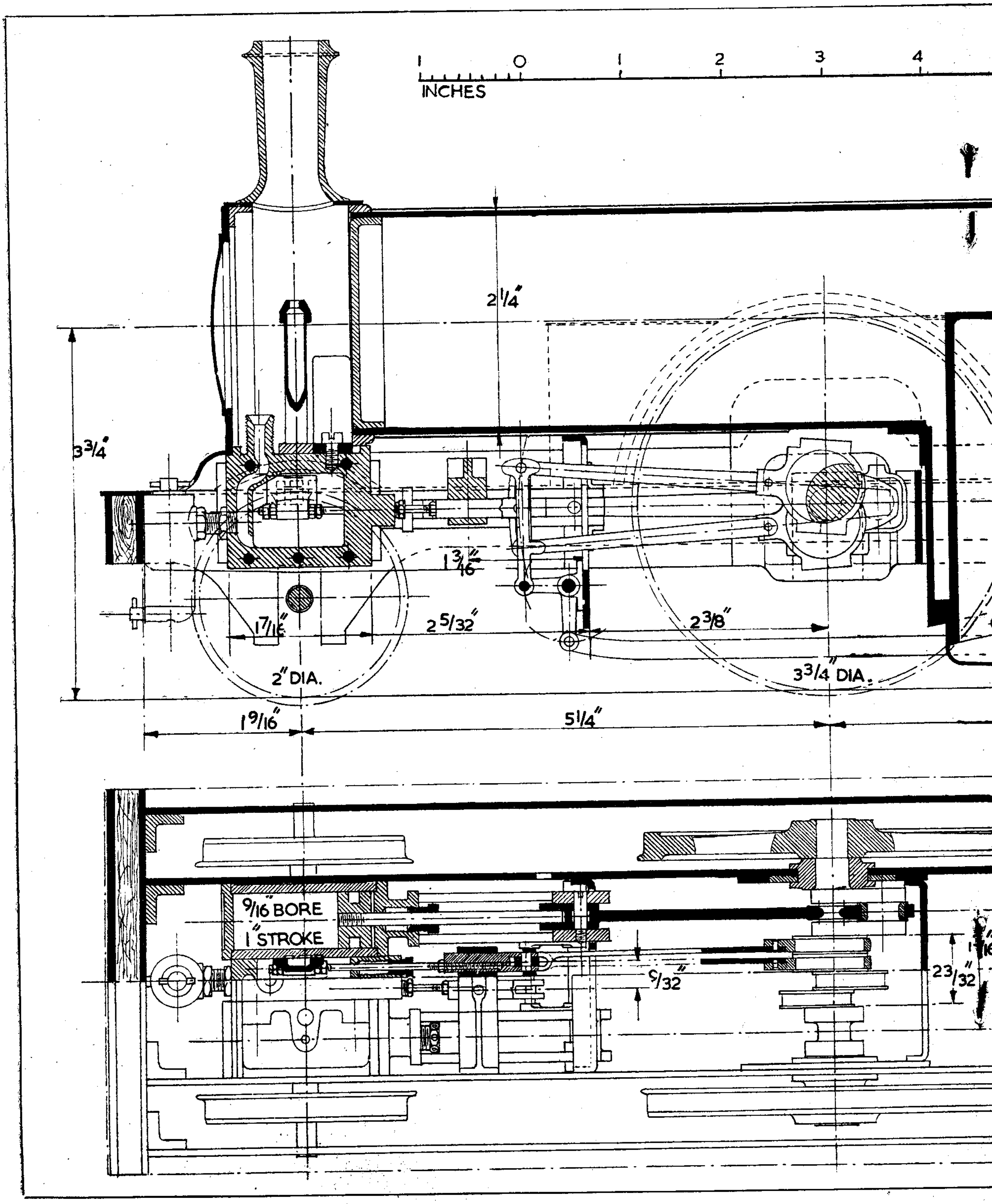
PATRICK STIRLING is always thought of as the creator of the famous 8-ft. 1-in. singles, which were in fact, the standard express locomotives on the G.N.R. for a period of 25 years, but he also built a number of six-wheeled singles which were very capable machines, and the larger ones performed work that was every bit as good as that of the 8-footers. The production of these machines started before that of the 8-footers, and continued to within a year of Stirling's death. The earliest of these six-wheelers, of which 12 were built in 1868-70, were distinctly smaller than the 8-footers which started to come out in 1870, but in 1885, two larger experimental six-wheelers were turned out, and they were found to be so successful that a number of larger ones quickly followed, 10 in 1886-88 and 11 in 1892-94. Actually, these 21 machines carried the same boiler as the 8-footers, and had slightly more cylinder power. It would seem as if Stirling could not quite make up his mind, but he certainly built many more of the 8-footers, 47 of the standard type over a period of 23 years, and six of the larger type during his last two years.

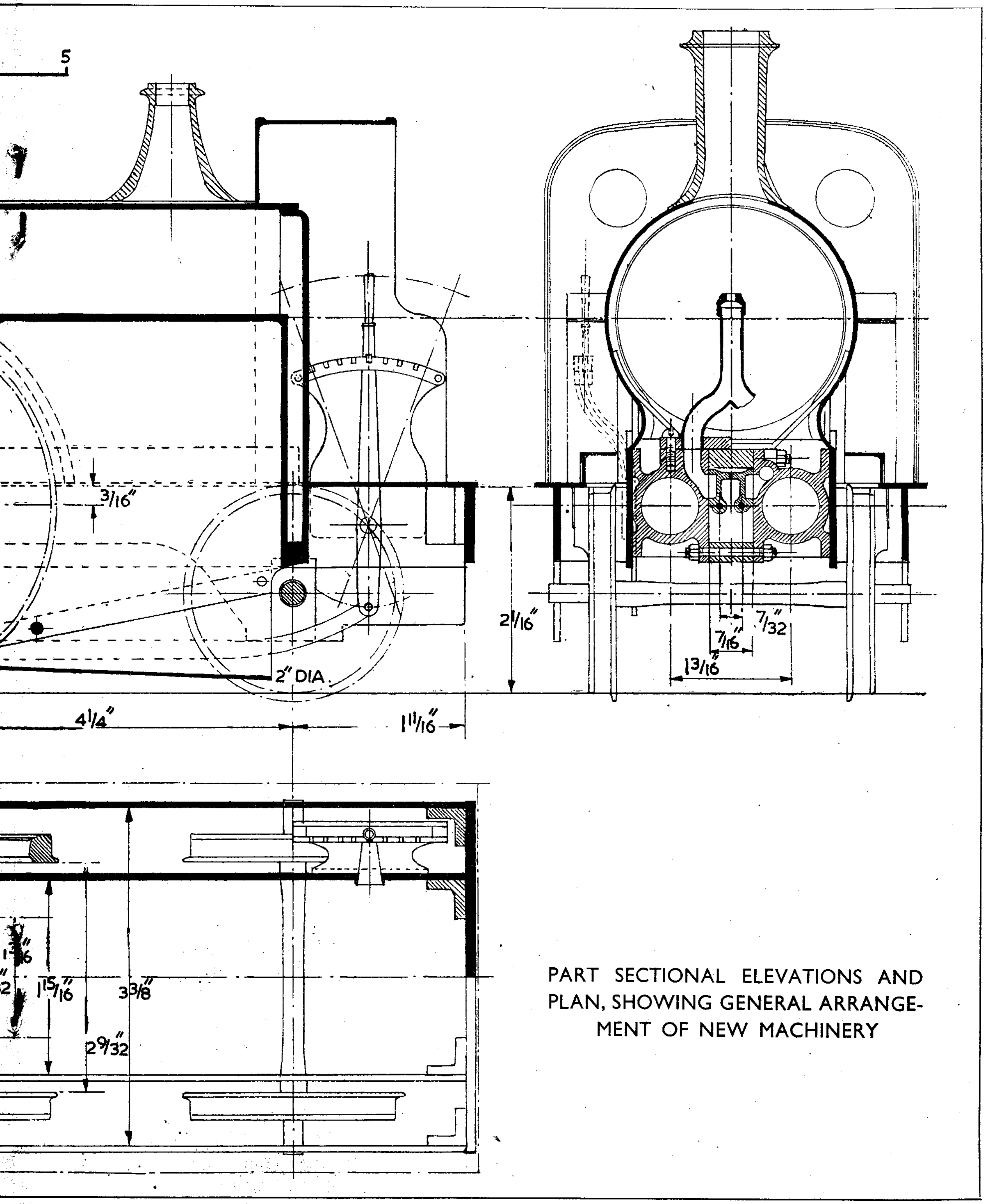
I have always been greatly attracted to the larger six-wheelers; their appearance was simple in the extreme yet they had plenty of character, so I was very pleased when I was able to acquire a very fine model of one of them. It is a model of one of the last batch built in 1892, ½-in. scale, and was built by the Southwark Engineering Co. in 1906. I purchased it from Mr. C. G. Harrison in 1920; he had used it quite a lot on an outdoor scenic railway. The appearance was very true to scale, although there were many minor deviations, the character and personality of the original were all there. The boiler was of the proper locomotive type, riveted throughout, but only caulked with soft solder. Firing was by methylated spirit; the machinery was very simple, slip-eccentrics with valves underneath.

When I acquired it, the model was considerably dilapidated, so I stripped



The locomotive as now running


INCHES
1 0 1 2 3 4
2 1/4"
3 3/4"
1 3/16"
1 7/16"
2 5/32"
2 3/8"
2" DIA.
3 3/4" DIA.
1 9/16"
5 1/4"
9/16" BORE
1" STROKE
5/32"
23/32"



PART SECTIONAL ELEVATIONS AND PLAN, SHOWING GENERAL ARRANGEMENT OF NEW MACHINERY

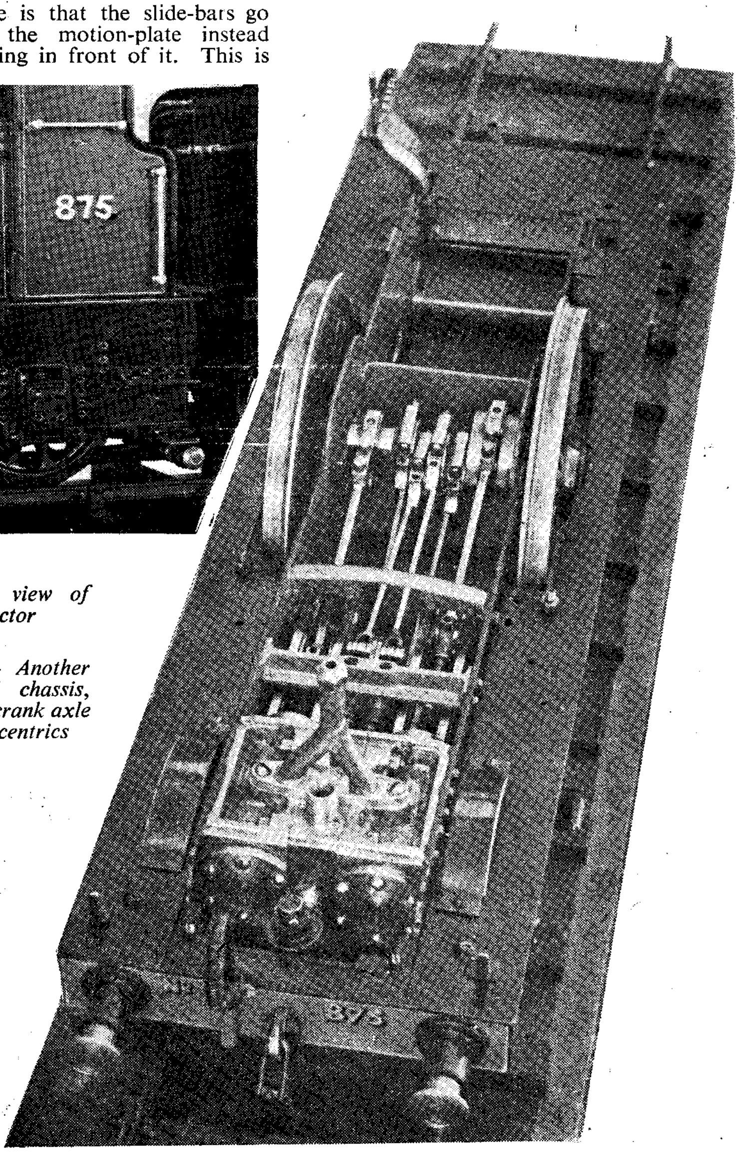
it down, corrected a number of details and repainted it, and so it remained as a show piece, until I thought it would be nice to have it in a really workable condition. In my opinion, the most important condition was to have at least all the inside of the boiler hard-soldered, so in 1932, the insides were completely removed and new ones fitted, and, of course, adapted to burn coal; the outside shell was quite suitable. At the same time, among other things, a crosshead water pump and cylinder lubricator were fitted.

In its altered form it ran and steamed very well, and although it would not take me up my 1 in 36 gradient, it had quite enough adhesion for passenger hauling on the level. The cylinders were $\frac{9}{16}$ in. by 1 in., wheels $3\frac{3}{4}$ in. and pressure 75 lb. sq. in.; they are the same now, as there was always plenty of cylinder power. There was, however, one rather bad fault; it was not good at keeping on the rails, almost entirely due to insufficient rise and fall of the leading axle, and the cause of this was rather fundamental. This type of locomotive with a low-pitched boiler and a leading axle right under the smokebox, really has no room for any type of cylinders except those with the valves in between, and in this model with the valves underneath, in spite of the steamchest cover being only $\frac{1}{16}$ in. thick, and the leading axle only $\frac{1}{8}$ in. diameter, the latter only had about half the amount of movement it should have had. So, for a long time, the thought was in my mind that it must eventually have machinery like the original and in 1943 drawings were made to this end, but work was not commenced until last year.

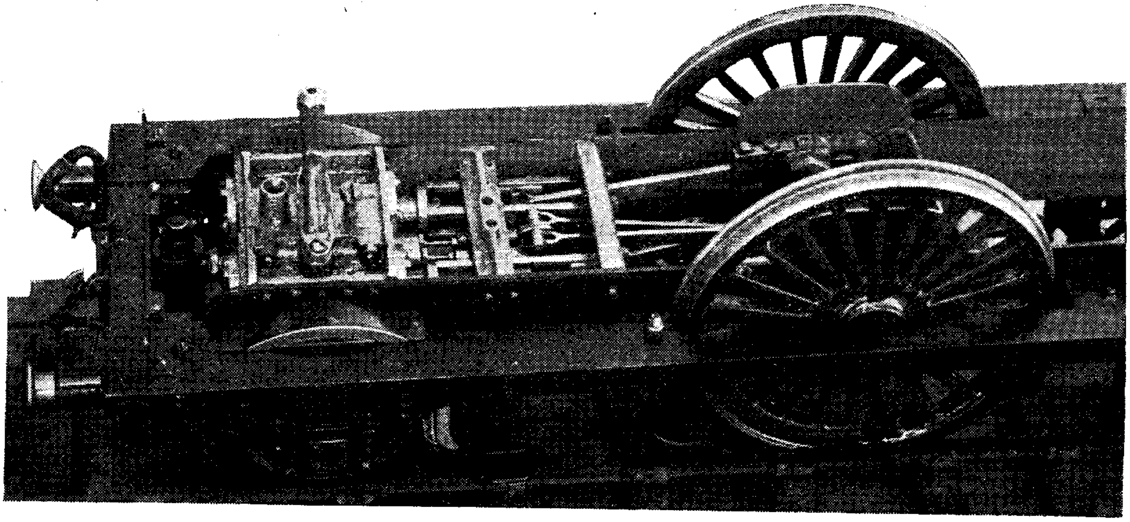
Fitting nice machinery to this type of engine presents quite a number of problems; as I have already said, the valves must be between the cylinders, and this in itself is quite a problem in this small size. Then the low pitch of the boiler and large driving wheel give very little clearance for the big-ends, eccentrics and links, the latter all but touch the barrel in full back gear, and the lagging of the boiler has to be removed above the big-ends and eccentrics. Even so, a strapped big-end is essential. Actually, the new machinery, both in general arrangement and detail, is very much like that of the original. Of course, the cylinders are different internally, but the chief observable difference is that the slide-bars go through the motion-plate instead of stopping in front of it. This is due to the model needing more space for the stuffing-boxes, and also the small-end is solid instead of being strapped.

There are four slide-bars per cylinder, and there is a separate stretcher carrying the valve spindle guides, thus allowing long eccentric-rods. This was a standard G.N.R. practice carried on into Ivatt's day; the layout of the link motion and reversing arrangements are strictly to the Doncaster drawing, and in spite of the before-mentioned handicaps, I managed to work in a bit more valve travel than the scale amount. The eccentrics are solid with the axle,

Close-up view of injector



Right — Another view of chassis, showing crank axle and eccentrics



The chassis with new machinery fitted

so this allows greater throw without increasing the size of the eccentric sheave, and a longer link was possible, as in the model the ends of the link cannot be moved so near the valve spindle in the full gear positions. This longer link keeps the angularity down, in spite of the greater eccentric throw, and also enables a greater proportion of this to be transmitted to the valve.

The eccentric travel is 11/32 in.—a scale 8¼ in. against 6½ in. of the original; valve travel about 7/32 in.—a scale 5¼ in. against 4¼ in.; the lap is the same, 3/64 in. or 1⅛ in., links a scale 19½ in. against 16 in.

The design of steamchests and valves, must, of course, come quite away from that of the big engine if the model is intended for use, and the one item that cannot be scaled is the distance between the valve spindles, and this controls the whole design. In the original, this dimension is 3¾ in., that is a scale 5/32 in., quite unobtainable; but by using valve spindles only $\frac{1}{16}$ in. diameter and glands screwed 5/32 in. by 60, I have got the centres down to 7/32 in., and as large ports are not very necessary on this type of locomotive, these are cut entirely above the cylinder centre-line and so allow the valve faces to be quite a distance apart. Actually, if one used buckles round the valves it would save quite a lot of room and the ports could then be cut on the centre-line.

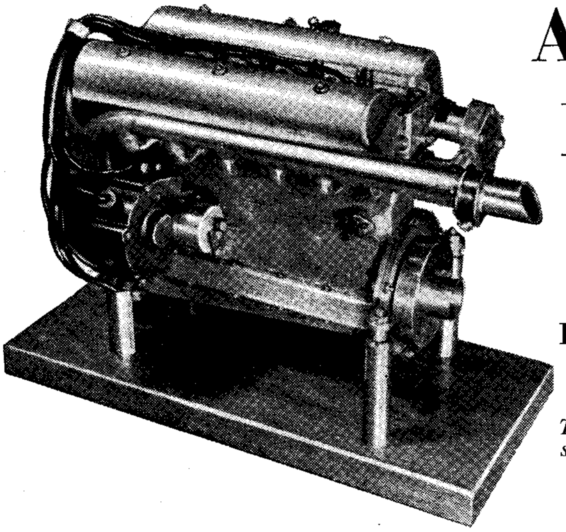
In this connection, it is worth noting that one of the most successful designs for large cylinders with the valves between, that of the 19-in. McIntosh ones, the valve spindles were carried considerably above the centre-line of the cylinders, with the result that 88 per cent. of the passage area was above that line and consequently was able to get into the exhaust passage without any obstruction. Although valves between was a common British practice, as long as flat valves were used, there were very few successful engines so arranged when the cylinders were over 18 in. diameter. These G.N.R. singles were among the few, yet the design gives hardly any clue as to why this should have been so; the valves spindles were on the cylinder centre-line so that half the port and passage area was below this line and had to pass upwards through the valve cavity and the exhaust port where it was smallest, before it could reach the exhaust passage. The exhaust port was certainly wide, 4 in., and this did help, as the area was considerably above that of the lower passage; but these latter were definitely small, in fact, just about half the area of those on the Drummond Caledonian engines with 18 in. cylinders, and these were 18½ in. And, on paper at any rate, the front end of the steamchest should have been short of steam, as both steam-pipes fed the back end, and the only way to the front end was the space over the top of the valves, which was only about ⅔ of the area of one steampipe. Yet these engines ran fast, pulled hard and steamed well, not once or twice, but always. The only other help to good performance was the exhaust exit, this was good.

The fitting of the new machinery met with no difficulty, but entailed a good deal of work, as the chassis had to be virtually rebuilt. All the new work is shown in the drawing, and calls for little comment. The patch over the driving axle was needed because the frames were very weak here and the axleboxes very shallow, the only old cross-member was a very flimsy one carrying the slidebars. A new crank axle was, of course, needed, but the other two had to be replaced as well, as all the wheels were $\frac{1}{16}$ in. too wide in gauge; this in part had contributed to the derailing trouble, there had been considerable side play on both leading and trailing axles, but now only the leading axle has it.

There had been no difficulty about fitting the crosshead water-pump to the old motion with its single slidebars; but now it was impossible to work it in, and the only alternative was an injector, and even for this there was not much room. I expect I could have found room for one of my own standard type, but fortunately, I had by me a very compact little one made by a friend of mine, Mr. Notman, who specialises in the moving-cone, Gresham and Craven type, and this fitted in very nicely in the proper place. It has a No. 80 delivery cone and is fully lifting and restarting. I think it is not quite so foolproof as my own design, but it is more efficient, requiring only a No. 76 steam cone in place of the No. 74 that I should have to use; the delivery rate is the same, about 3½ oz. per min., and it does not seem to worry this small boiler in the least. The check valve and steam valve were made as one fitting, much the same as on the big boiler, but, of course, taking up rather more room; the photograph of the footplate shows that there is not much room to spare. Incidentally, the reversing lever is bent like this on the original, but it is a bit more bent on the model so that one can get one's finger between it and the boiler.

The work done necessitated the engine and tender being repainted below the footplate level, but the upper works have only been touched up and still look very well.

In conclusion, I should like to acknowledge my indebtedness to the courtesy of British Railways, Eastern Region, for drawings and information about these interesting locomotives.



A SIX-CYLINDER PETROL ENGINE

With Twin Overhead Camshafts

By F. W. Watcrton

The completed Engine is shown here, mounted on its temporary bed

THE magneto is of the rotary magnet-type, now more or less standardised in model sizes. The general appearance may be seen on the photograph, Fig. 5, while the detail design is given in the general arrangement drawing, Fig. 4, and detail drawings, 6 and 7.

The first part to be constructed was the rotor shown in detail in Fig. 7. This consists of an Alcomax magnet 15/32 in. square by $\frac{9}{16}$ in. long, which is held between two dural half shafts, slotted, and spigoted together. The two soft-steel pole pieces are fitted up against the ends of the magnet by cutting away the sides of the dural shafts level with the ends of the magnet. The two halves of the shaft, the magnet and pole pieces were then clamped together, drilled and riveted together with four bronze rivets as shown. The assembly was then turned up between centres to the finished sizes on the detail sketches.

The stator was built up from transformer stampings 0.014 in. thick, clamped between two pieces of $\frac{1}{16}$ in. sheet steel. Extra $\frac{1}{16}$-in. pieces were fitted to the sides round the rotor tunnel. The stampings are riveted together with 0.064 in. rivets as shown on the detail and machined up to the finished dimensions. The bore of the stator should be 0.003 in. larger than the finished rotor. The bearing housings are machined from solid dural bar and are straightforward jobs. It should be noted that one of the ball-races is insulated from the housing by a bakelite ring to prevent circulating currents through the shaft which are apt to damage the bearings. The windings are put on the yoke of the stator in a winding machine used for other similar jobs.

The primary consists of four layers of 0.0124 in. diameter enamelled copper wire, approximately 55 turns per layer. One end is soldered into a hole in the yoke, and the other brought out for connection to the contact breaker. One turn of varnished cloth insulates the primary from the core, two turns of 0.001 paper are put between layers and over the last layer. The secondary winding is laid on the primary directly and consists of 12,000 turns of 0.0012 in. enamelled copper layer wound with one turn of 0.001 in. paper between layers. The winding is started and finished with a few turns of 0.002 in. wire which are connected to strips of 0.005 in. copper $\frac{1}{8}$ in. wide, the start being soldered to the core. The finish tab is fitted with a small brass stud which projects through the outer insulation for connection to the spindle of the distributor by means of a spring.

The secondary winding insulation is graded as the winding progresses by shortening the length of the layers. The secondary is also reinforced near the sides of the yoke by pieces of mica inserted between the layer insulation and the yoke. The complete windings are insulated by immersion in molten wax until all bubbling has ceased. The wax with the winding is allowed to set and cool and then reheated fairly quickly. This treatment heats up the wax first and allows the stator and windings to be lifted out with a good coating of wax still adhering. The greater heat capacity of the stator slows up the melting of the wax on the windings and keeps sufficiently solid to prevent the ingress of air and the formation of voids when the windings cool. The excess wax is

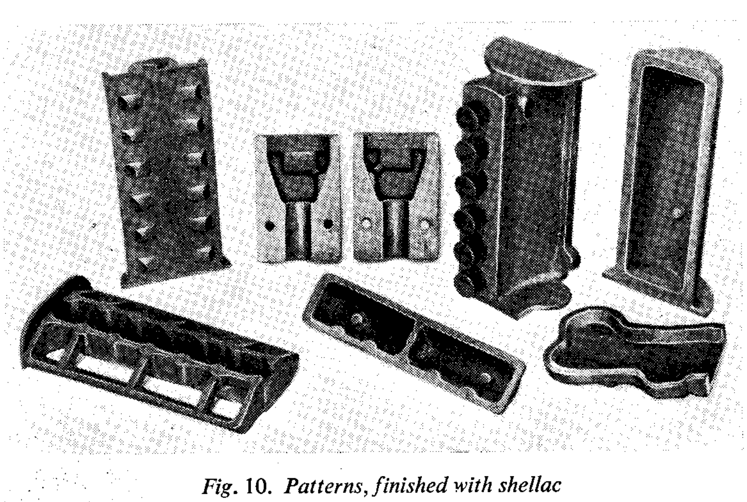


Fig. 10. Patterns, finished with shellac

Continued from page 771, June 25, 1953.

trimmed off and the windings varnished with several coats of shellac and finished with good quality yacht varnish.

Attention was then turned to the distributor, which was made in two main parts spigoted together. The main part is a push fit on to the bearing housing at the contact breaker end and is counterbored on the opposite side to house the bakelite gear which drives the distributor arm. A steel spindle bolts through the back of this body to carry the spring connecter for the high voltage and serves as the bearing for the distributor. Six terminals are fitted at equal intervals round the casing to carry the spark to the plugs. The distributor gear is from $\frac{1}{8}$ in. fabric bakelite sheet and is a 60-tooth 40 d.p. wheel and meshes with a 20-tooth steel wheel on the armature shaft. This steel gear is integral with the two-lobe contact breaker cam as shown on the additional sketches. Another ebonite piece covers the distributor and gears and also carries the contact breaker and, incidentally, a small brass pad is inserted to keep the distributor in position on its shaft. The contact breaker is of the solid arm pattern as shown on the sketch, Fig. 6, with a fixed insulated contact and semicircular spring. The base is turned and milled from a piece of 1 in. diameter dural rod. The contact arm is also dural with a bakelite pad riveted on for the cam to strike. Adjustment of the contacts is obtained by turning its pivot—an eccentric bush—on a clamping screw. Advance and retard is provided by turning the whole contact breaker. The cover is also made from dural and is held in position by the usual spring. The primary circuit is completed by connecting the fixed contact via a terminal through the contact breaker cover through an ignition switch to a terminal on the main portion of the distributor housing.

The windings are protected by a metal cover which also houses the condenser and bolts on to the back of the distributor. The magneto is driven by an 18-tooth 40 d.p. wheel pinned on to the shaft. This gear projects into the timing gear cover and is driven through a 48-tooth idler from the 24-tooth gear on the crankshaft.

On test, the magneto gave 5,000 volts at 500 r.p.m. which is much slower than the engine was expected to run and corresponds to a crankshaft speed of 330, a fact which, no doubt, contributes very largely to the easy starting of the engine. Incidentally, one indication of a badly-oiled plug is the sparking over from the plug top to the cylinder head—a distance of $\frac{3}{8}$ in. As originally completed with an aluminium cover over the windings and complete with the six H.V. leads, the magneto weighed 9 oz. and the base will sit on a one-time penny matchbox. As the aluminium cover was damaged beyond repair by our good friends, the British Railways, it was replaced by a brass one which has put the weight up a little.

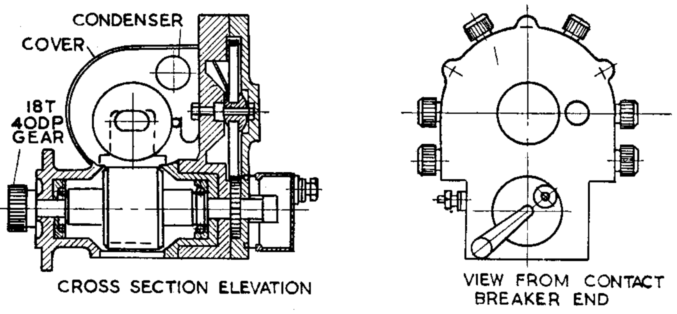


Fig. 4. General arrangement of magneto

Having completed the magneto, a start was made on the engine by making a pattern for the cylinder block. This was a straightforward piece of woodcarving—the shape of the finished block plus machining allowances and coreprints to locate the cores for the six cylinders. A corebox was made in two parts located with respect to each other by two $\frac{1}{4}$ in. diameter steel pegs. These were sent away to the foundry and while waiting for the casting a start was made on the crankshaft.

Crankshaft

A great deal of thought was given to developing an accurate method for setting the cranks at 120 deg., and also to ensure their axes were parallel to the main journals. The following method was finally adopted.

A bar of 3 per cent. nickel steel $8\frac{1}{4}$ in. long and $1\frac{1}{4}$ in. diameter was centred at each end and mounted between centres in the lathe and a spigot 0.35 in. diameter and $\frac{1}{8}$ in. long turned on both ends. The bar was then laid aside and twelve buttons were turned up, four 0.35 in. diameter and $\frac{3}{16}$ in. long with a 3/32 in. central hole and two 0.35 in. diameter by $\frac{1}{8}$ in. long with a 3/32 in. central hole and the remaining six 0.35 in. diameter blank and $\frac{1}{8}$ in. long. Two brass rings were then made 1.05 in. bore and about 3/32 in. long. These buttons were assembled as shown on the sketch, Fig. 8, six on one end first, with the long buttons located as shown. The blank buttons were placed alternately with the drilled buttons and clamped in position with a screw and a washer, and a drill was sent through the drilled buttons into the crankshaft blank. The assembly was duplicated at the other end while the buttons at the first end were located by pegs pushed into the drilled holes in order to obviate any possibility of the buttons shifting with respect to the crankshaft. The longer buttons were now used to line up the holes at the two ends by setting them against a pair of ground parallels on the lathe bed. The second set were clamped up and the alignment checked end for end by reversal and, finally, the holes drilled through the second set of buttons. This method ensured that the centres obtained, were at 120 deg. and lined up end for end, and also gave the correct stroke to all cylinders of 0.7 in.

It should be emphasised that the buttons must all touch each other and the spigot on the shaft and, if done properly, will roll round the shaft like a cageless roller bearing.

The crankpins were then turned in pairs, the centre pair first, working outwards, numbers 1 and 6 last. Each crank, as completed, was packed by a brass block soldered in position. These blocks had to be very carefully fitted otherwise the shaft would have been bent. After all the crankpins had been turned, the shaft was skimmed over the webs and the journals turned up with the three "point" steady to take some of the thrust. The tapers for flywheel and starting pulley

and 9/32-32 t.p.i. threads for the nuts were finally turned on the ends of the shaft. When finished and checked with a clock, all throws and journals were within 0.001 in. of the required sizes. The two tools, used for all turning on the shaft journals, No. 1 for roughing and No. 2 for finishing, are illustrated in Fig. 9.

The blank for the gear wheel is integral with the shaft and was cut by mounting on the "Shapo-Miller" in the dividing head by means of a tapered adapter and drawbar, which were made to fit the taper and thread on the starting pulley end of the shaft. The gear—24-tooth, 40 d.p.—was milled with a cutter made on the pantograph grinding device described in the "M.E." some time ago.

The oilways were drilled many months later in a bench drill and are all $\frac{1}{16}$ in. diameter. They were started from the crankpin ends and a centre was obtained with a spherical ended dental burr. The shaft was mounted on vee-blocks held in a machine vice bolted up at the correct angle on to the vertical face of a 6 in. angle plate. Care had to be taken to avoid breaking the drill as it was cutting through the journal surface at 45 deg. and these points were finished with the dental burr.

The crank webs were cut into shape for balancing after the remainder of the engine had been made, and were milled in the "Shapo-Miller"; the shaft was gripped by two split blocks on the journals adjacent to the webs to be milled. The machine was set up and the shaft turned over on to a setting block so that the webs were symmetrical with the crankpin and all the same size and shape. It should be borne in mind that some five years elapsed between the start and finish of the operations on this shaft.

As the shaft was the first main item to be machined, I kept a record of the number of hours taken on the various jobs and the total came to 66: buttons—8 hours; turning all journals and tapers and webs—44 hours; cutting gear—2 hours; oilways—6 hours; cutting balance weights on webs—6 hours. Needless to add, I soon got tired of keeping record, as it made me feel depressed.

Patterns

The cylinder block casting duly arrived, but when I started to consider the machining problems, I found that very little could be done without the other castings, as some of the faces, in particular the timing gear cover and sump, had to mate with several castings, and machining operations would be most easily done when they were bolted together.

Consequently, the remainder of the patterns, consisting of the sump, timing cover, cylinder head, water jacket and valve boxes, valve covers and water pump, were made partly by carving from solid and partly by building up from pieces. At this stage, the valve covers and sump were modified and given partly circular outlines in section. to improve the appearance. Incidentally, the curves are very easily made by heating a bit of $\frac{1}{16}$-in. ply, bending it round the curved ends and gluing in position. The patterns which are shown in Fig. 10 were finished with shellac and sent away to the foundry. I usually find it convenient to work out some details of the design when making the patterns, as this saves drawing a lot of detail sketches. Bits of wood and glue are excellent "putting on" tools and the various odds and ends like flanges and bosses can be marked out on the surface of the raw material.

Cylinders

The cylinders, which are wet liners, were turned and bored in pairs from 1 in. diameter cast-iron. A piece of metal $3\frac{1}{4}$ in. long was held in the three-jaw chuck and one liner turned and bored to the sketch, Fig. 11. The bore was left 5 thou. undersize, but the outside and spigot at the top were finished to size. The piece was then gripped by the partly-finished liner and the second turned up as the first had been. The second cylinder liner was then parted off and the first, which was, of course, still in the chuck, finished to length. About 0.020 in. extra was allowed on the top ends for finish machining. The liners were finish bored and lapped to size after they had been pressed into the cylinder block, and were nickel plated on the outside to reduce the danger of rusting in the jackets.

The flat horizontal surfaces of the head and cylinder block were planed up on the "Shapo-Miller," about 0.020 in. left on the cylinder head joint face of the cylinder block for finishing when the liners had been inserted.

The cylinder block was then set up on a 6 in. angle-plate on the cross-slide of the lathe. Perhaps I should mention the cross-slide was made from a set of Tom Senior's castings for an extra long cross-slide for a 4 in. "Drummond"—only the Senior design was turned upside down. The saddle was made from the Senior top part and my top-slide was made from what should have been the saddle. The top-slide is, as a result, 13 in. long and $4\frac{1}{2}$ in. wide, with slots parallel with the bed every $1\frac{1}{2}$ in. and with a travel of over 7 in. The large flat surface and long travel were "just the job" for boring cylinders, etc., as once the block was set up, each hole in

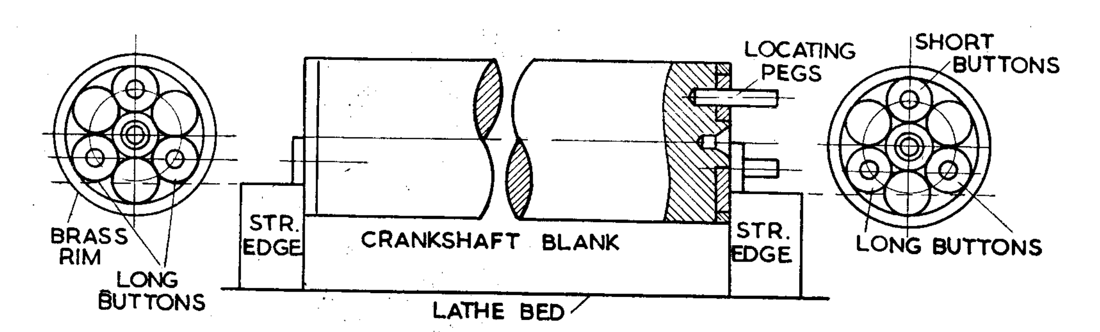


Fig. 8. Set-up for drilling crank centres

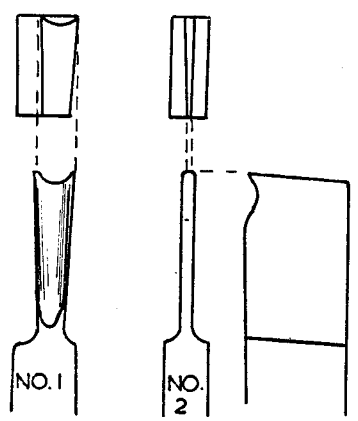


Fig. 9

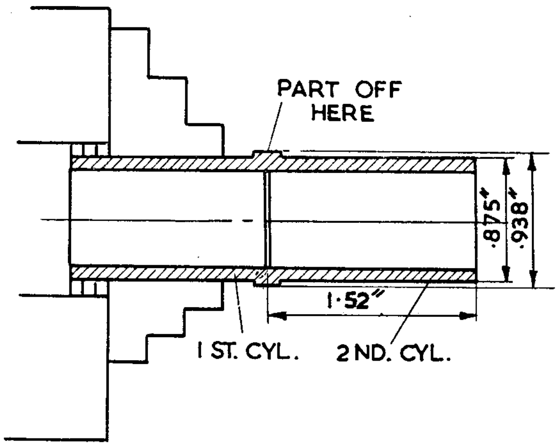


Fig. 11

the outer jacket could be bored in turn and then the slide traversed to the next and so on until all six were completed. All the machining was done by means of ordinary boring tools held in the four-jaw chuck. The chuck jaws were adjusted to put on the cut as required. After the liners had been inserted, they were finish bored, using the same set up.

All the cylinder head studs and main bearing studs, etc., were made and fitted. The cylinder head was drilled first and used as a jig to drill the cylinder block and head water jacket. The water jacket, cylinder head and cylinder block were all bolted together, mounted on the cross-slide and the timing gear face milled with a single point cutter bolted to an angle-plate in turn bolted to the faceplate.

The head and studs were removed and the cylinder block fitted with the main bearing caps made from $\frac{1}{4}$ in. dural plate.

The block was then put up on the vertical slide and lined up with the lathe centres for progressive line boring the main bearing housings from the timing gear end.

The first pair were easy, being drilled $\frac{3}{8}$ in. and opened out to $\frac{7}{16}$ in. using a tool in the four-jaw chuck. The remainder caused a little more trouble, mainly due to uneven thickness in the casting and bearing caps. A $\frac{3}{8}$ in. bore brass sleeve had been made $\frac{7}{16}$ in. o.d. to fit the finished housing, i.e. No. 2 bearing and this was used to steady a $\frac{3}{8}$ in. drill (with an extended shank soldered on) which gave a rough hole for No. 3 bearing. An accurate ground silver-steel boring bar with a single point cutter was then passed once through No. 3 housing, using a fine feed on the self-act. The bar is supported on No. 2 bearing by means of the brass bush already referred to. The brass bush was transferred to No. 3 and No. 4 drilled and bored, and so on until all were complete. The timing cover and sump were then bolted on to the cylinder block without removing it from the lathe and the $\frac{3}{8}$ in. hole bored for the starting pulley end of the crankshaft to pass through. An annular recess should now be machined in this bearing for the felt or synthetic rubber packer to stop oil leaks.

The sump should next be removed and a boring bar with a large cutter fitted up to trim the sides of the main bearings to the correct thickness of $\frac{1}{4}$ in. The only way I could see to do this was to use a spot-facing type of cutter which would sweep the whole face of the journal. Fortunately, the material was aluminium and use was made of the brass ferrule to steady the bar adjacent to the face which was being cut. The cutter had to be removed from the bar when changing over from one bearing to the next. Using a slow speed and a bit of "gently does it," a good finish was obtained without chatter marks. The method was quick, and much easier than the only alternative, which was to use an end mill which would have meant a fresh set up.

(*To be concluded*)

FINISH ON MYFORD LATHES

We have been asked by the Myford Engineering Co. Ltd., to correct any wrong impression which may have been caused by a comment by our contributor Terry Aspin in his article "Bringing it up to Date," in our issue of May 28th, regarding the painting on his M.L.7 lathe. They inform us that the subject of painting and surface finish generally on all Myford products, has been given special attention. They furthermore affirm that it is an acknowledged fact throughout the trade that "Myford finish" is a superior finish.

The reference in question was written in semi-humorous vein and we know that the finish so described does not apply to Myford products. From personal experience with Myford lathes, we can endorse their statements, as we have found them beyond reproach in the matter of finish ; and further, we have inspected the painting and finishing departments of the Myford works and have been much impressed by the efficiency of their equipment, which includes modern facilities for automatic degreasing, bonderizing, filling, smoothing, with spray booths for cellulose, synthetic and stoving enamels and stoving ovens. We were impressed by the thoroughness in the way the various finishes are applied.

IN THE WORKSHOP

BY DUPLEX

A LATHE MILLING ATTACHMENT

THE steel bevel crown wheel and pinion illustrated in Figs. 14 and 15 were fortunately found amongst the oddments in the box kept for spare fittings; for machining gear wheels of this kind with the correct tooth form is not always practicable in the small workshop, and they are, perhaps, better obtained commercially. The actual tooth pitch is not important, and the gears can quite well be of equal size. But as an overall reduction of approximately 10 : 1 in the drive was aimed at, this was obtained by fitting bevel gears having 22 and 36 teeth in conjunction with the backgear reduction of $6\frac{1}{4}$: 1. The total reduction ratio, therefore, works out at 10.2 : 1.

The Drive Assembly (See Fig. 3)

The baseplate (*K*) is bored a close fit on the upper end of the spindle housing (*D*), and is then firmly secured in place by tightening the Allen clamp-screw.

To the plate (*K*) is attached the bracket (*L*), forming the headstock assembly, and carrying bearings for both the mainshaft and the backgear layshaft. Readers should note that, when compared with Fig. 16, the drawing in Fig. 18 is reversed from right to left. In addition to the machining already carried out, the sides of the baseplate are recessed for the two side plates, fitted for the purpose of bracing the headstock; the method of machining adopted is illustrated in Fig. 17, and the side plates themselves are shown in previous photographs as well as in the dimensioned drawing which will appear in the next instalment, for the plates are best fitted at a later stage.

As will be seen in Figs. 18 and 19, the headstock is, again, built up from steel plate, and the parts are held together with Allen cap-screws. After the two bearing plates have been marked out, the holes for the bearings and bearing bushes are drilled and rough-turned undersize; next, as shown in Fig. 20, these plates are secured to their baseplate, and the assembly is then mounted on the faceplate for boring the bearing housings in true alignment and to the finished diameter.

Continued from page 740, June 18, 1953.

As will be described later, the two sets of wheels fitted to the backgear have 20 and 50 teeth of 20 diametral pitch; but in the event of wheels of a different size being used, the following calculation may prove helpful.

In the present instance, the distance between the wheel centres is:

$$\frac{50T. + 20T.}{2 \times 20 \text{ D.P.}} = 1.750 \text{ in.}$$

With the crests of the teeth touching, the inter-centre distance becomes:

$$\frac{(50 + 2) + (20 + 2)}{2 \times 20 \text{ D.P.}} = 1.850 \text{ in.}$$

The distance between the wheel centres given in Fig. 19 is 1 27/32 in. or 1.8438 in.

However, as will be seen later, the eccentric mounting of the backgear layshaft, amounting to 3/32 in., allows the gear wheels to be rocked either correctly into mesh or into the disengaged position.

The Drive Spindle (M)

This part is turned between centres, and the three Woodruff keyseats are afterwards machined, with the spindle gripped in a machine vice attached to the vertical slide.

As the spindle, when in operation, is not heavily loaded, it can quite well be made of mild-steel; but, if preferred, an alloy steel can be used, and this will give longer bearing life without adding appreciably to the difficulty of machining. In any event, the journals are best lapped to a good finish.

The front and rear bearing bushes (*N*) and (*P*) were turned from centricast iron rod, and are made a firm press-fit in their housings. If the bores of the bushes are lapped to a close running-fit on the spindle, this will make for quiet running and freedom from wear.

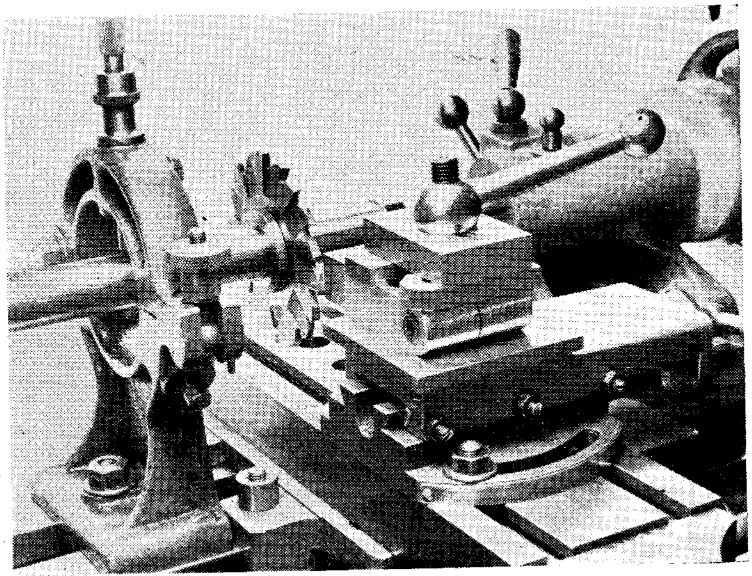


Fig. 17. Milling the baseplate for the side plates

The Sleeve Gear (S)

This pinion carries the belt driving pulley and, by releasing the pulley lock, the assembly is made free to turn on the driving spindle when the backgear is engaged.

Mild-steel was used for the construction, but the pinion was afterwards case-hardened and the bore lapped to a running fit on the shaft.

The wheel blank was mounted in the Myford dividing attachment for machining the teeth, using a gear cutter made with the cutter machining equipment for the lathe, described by the writers in a previous series of articles. Advantage was also taken of this setting to machine the keyseat for the Woodruff key securing the pulley. The four radial drill holes shown in the drawing serve for the entry of oil into the inner shaft bearing. The outer surface of the sleeve is also lapped, as it runs in contact with the bore of the bearing bush (*P*).

The Belt Driving Pulley (Q)

The pulley was machined from $\frac{3}{8}$ in. mild-steel plate, and the V-groove turned in the rim is made to accommodate a $\frac{1}{4}$ in. diameter round leather belt. The bore is machined to a light press-fit on the end of the sleeved pinion (*S*). and a Woodruff key is fitted to take the drive.

Following the boring operation, and at the same setting, the pulley keyway is machined with a parting tool, mounted on its side at centre height, and the lathe saddle is then racked to and fro.

To secure the pulley axially after

Fig. 20. *Machining the headstock bearings*

Fig. 16. *The baseplate of the driving gear*

Fig. 18. *The drive headstock assembly*

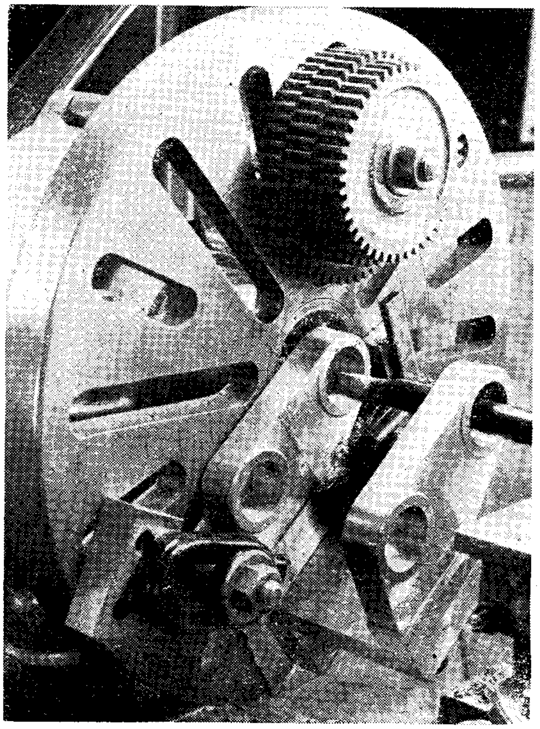


Fig. 20

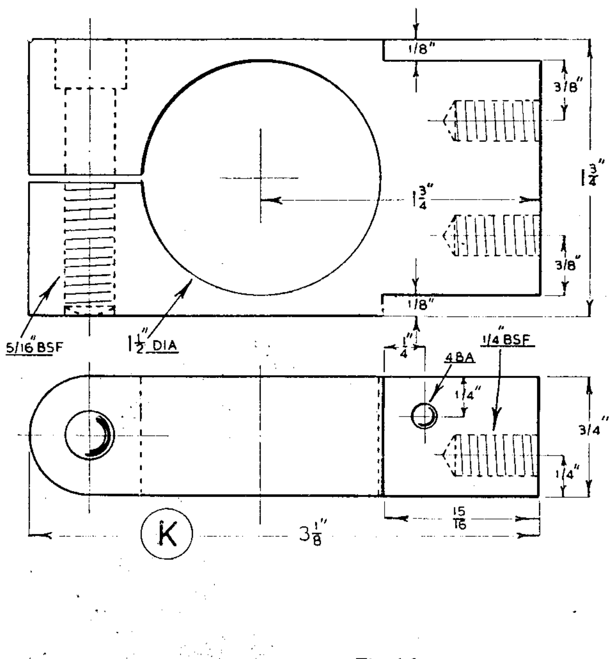


Fig. 16

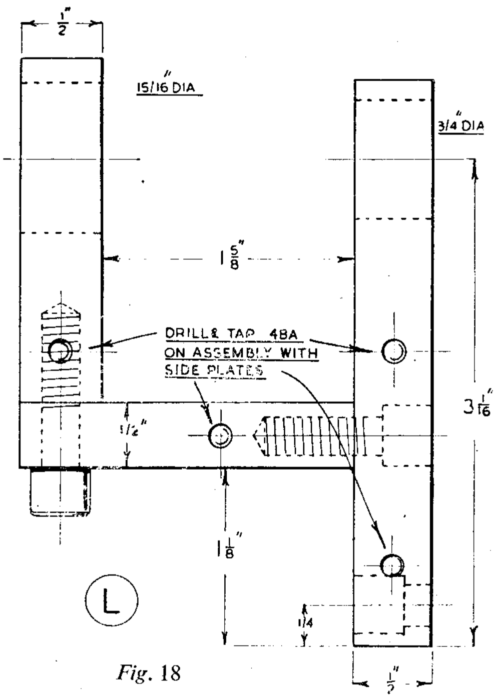


Fig. 18

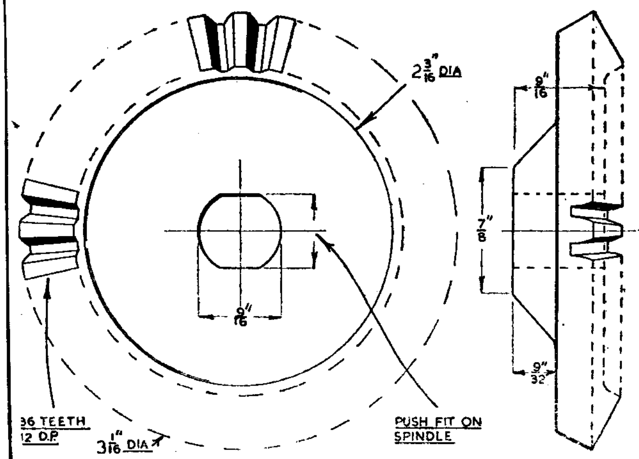


Fig. 14. *The bevel crown wheel*

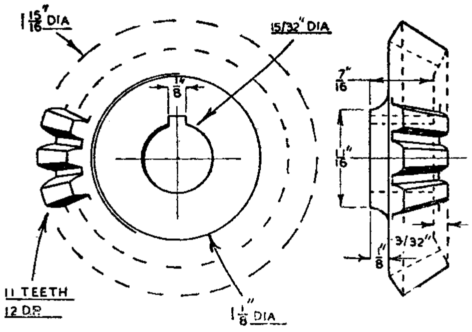


Fig. 15. *The bevel pinion*

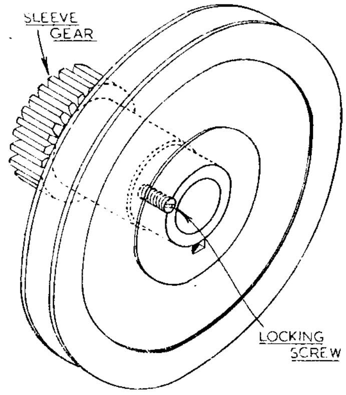


Fig. 23. *Showing the method of securing the pulley to the sleeved pinion*

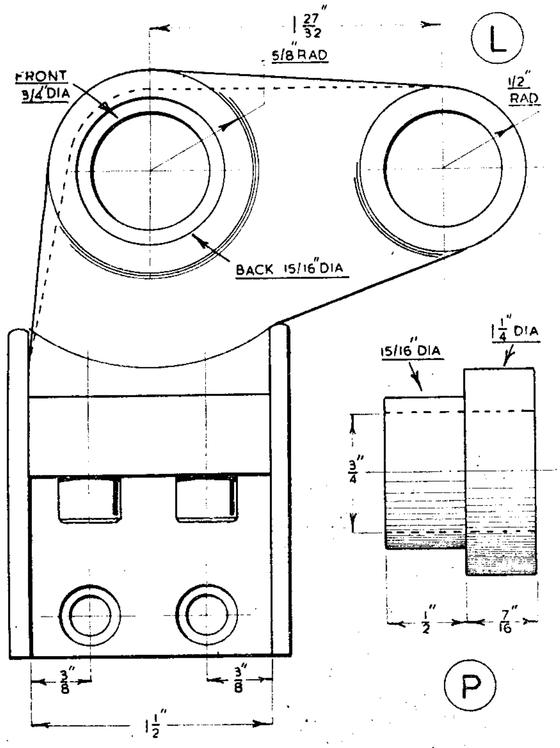


Fig. 19. *The headstock assembly—L, and the drive shaft rear bearing bush—P*

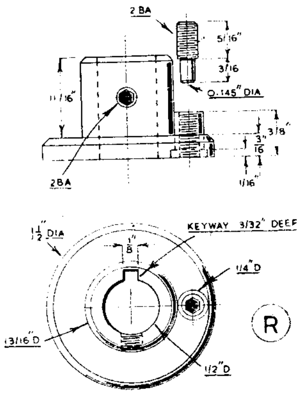


Fig. 24. *The pulley locking collar and latch screw*

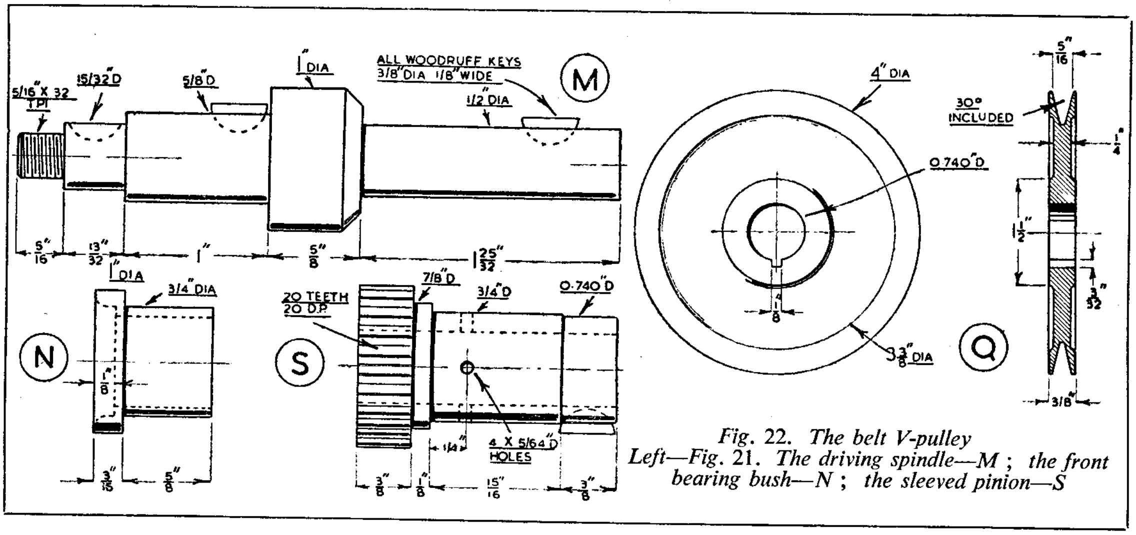


Fig. 22. The belt V-pulley
Left—Fig. 21. The driving spindle—M ; the front bearing bush—N ; the sleeved pinion—S

assembly, a hole is drilled, and afterwards tapped, half in the sleeve and half in the face of the pulley to take a 5 B.A. grub-screw.

The Pulley Locking Collar (R)

The pulley lock serves to lock the pulley, together with the attached sleeved pinion, to the driving shaft. The collar is secured to the shaft by means of a Woodruff key, and an Allen set-screw, engaging a dimple drilled in the shaft, affords end-location. When a straight-through drive to the bevel pinion is required, the 2-B.A. latch-screw is tightened so that its tip engages in a hole drilled in the face of the pulley. To engage the backgear, the latch-screw is withdrawn to render the pulley with its gear pinion free to rotate on the driving shaft; the lay shaft gears can then be put into mesh and the driving spindle will rotate at approximately one-sixth of the speed of the pulley.

To give the latch-screw a bearing of adequate length, the flange of the locking collar is drilled and an internally-threaded, shouldered bush is pressed in and firmly seated in place.

Accuracy

The hole in the face of the pulley to receive the tip of the latch-screw is next drilled; this hole is accurately located by first assembling the parts on the shaft, and then spot-drilling the pulley with a drill guided by the threaded bush; the hole is finished to the correct diameter and depth after the pulley has been removed from the shaft. To avoid unnecessary backlash, the latch-screw should be accurately fitted.

In the next instalment the fitting of the backgear will be described, as well as making the remaining components for completing the attachment.

(*To be concluded*)

Who's Who IN MODEL ENGINEERING

E. W. TWINING

Apart from his activities as a designer and constructor of a wide variety of models and experimental devices, Mr. Twining has a special claim to distinction as an artist and draughtsman, and indeed it can be stated that he has produced some of the finest engineering drawings ever published in "The Model Engineer." Born at Bristol in 1875, and educated at St. Mark's School and John Abel's private academy, he has had over 65 years of active experience in making models, his early efforts being aided by articles in the *Boy's Own Paper*, particularly those on locomotives, published in 1887. His early experiments with model aeroplanes made a notable contribution to the progress of design; he was the first winner of the Gamage and Wakefield Challenge Cups (1910-11), was on the council of the Kite and Model Aeroplane Association, which preceded the Society of Model Aeronautical Engineers (1912-13). For some years he carried on the business of Twining Models Ltd., leaving it in 1941 to take an appointment with the Bristol Aeroplane Company. At the end of the war, he took up stained-glass work for three years, and has since been in retirement from regular employment, though still active in model work. He has produced or designed several model and small power locomotives up to 15-in. gauge, including some for the Dudley Zoo, one of which, a 2-4-2 type, is still under construction. His other hobbies include astronomy and telescope making, photography, drawing and painting, including stained-glass windows; his contributions to literature include books on *The Art and Craft of Stained Glass*, *Heraldry*, and *Indoor Model Railways*.

READERS' LETTERS

● **Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.**

"THE PRICE OF THINGS!"

DEAR SIR,—The paragraph which appeared recently in "Smoke Rings" regarding variations in the prices of materials prompts me to write to you and list some of the trade habits which annoy me.

My first target is the advertiser who will not quote prices. It usually means that the cost is high in any case, but it may also mean that the quotation will depend upon who is asking.

Also, there is the advertiser who, when you write to him, tells you that he cannot supply direct and gives the name of his nearest agent. In my case this shop is probably at least fifty miles away and, when I write to him, I find that he has no stock and will have to order specially.

Possibly there are other workshop nuts who feel as I do about these nuisances.

Yours faithfully,
"SIMPLE SOUL."

MODEL ENGINEERING IN MELBOURNE

DEAR SIR,—I trust that the following news of activities in our society may be of interest to British readers.

My main interest, lately, has been "magnetos," which I have fitted to three engines. These are based on Edgar T. Westbury's design, and are an outstanding success. One has been fitted to a 25 c.c. vintage "Grayson" 4-stroke. The magnet used was from a BTH aircraft magneto, with a portion ground away to provide pole-pieces. The field laminations are bolted directly to the crankcase, with the coil across the top. Although the magnet is a cylinder $1\frac{5}{8}$ in. diam. × $1\frac{15}{16}$ in. long, with a bore of $\frac{7}{8}$ in. diam. and fitted in a gunmetal flywheel, the final weight of the engine is only $1\frac{1}{2}$ oz. greater than when a Ford V8 coil and lead-acid battery was used. The engine is used in a sealed-up version of the M.E. Hydroplane 36 in. long, and does a real job of work, which, when compared with recent "M.E." speed boat competition speeds, is dignified rather than spectacular.

Another magneto, running in a 15 c.c. two-cycle motor has outlived two engines, and appears to have suffered no ill effects despite several duckings. The first engine ended its career when a crankshaft failed in the crankweb whilst running at speed. The shaft had been turned from the solid from H.T. steel. A second engine was built and gave some good results in the past summer, until last Sunday week, when it appeared to take in water through the carburettor, and the cylinder above the exhaust ports gave way, blowing the head, liner, half of the cylinder block and plug some feet into the air, and then falling into five feet of water. The following week-end "pearl diving" was the order of the day, but we had no luck in finding the top half assembly.

A friend of mine who made a magneto fitted with a coil to E.T.W.'s design succeeded in passing 100 m.p.h. at the Victoria Race Car Club recently. The whole outfit, engine, chassis, magneto, etc., were built entirely by him. He is a moulder by trade, and a self-taught turner and fitter, using a $4\frac{1}{2}$-in. bench lathe. This seems the answer to those who are inclined to feel that $'s and American motors are necessary to reach high speeds.

Yours faithfully,
F. L. CARRIG, *Hon. Sec.*
Melbourne, Aus. S.M.E.E.

SMALL VACUUM BRAKES

DEAR SIR,—I find "L.B.S.C.'s" letter in the issue of May 28th most interesting. That interest is mingled with some surprise to learn that past comments on small vacuum brakes, made by me recently, are unconvincing, contradictory and incapable of being analysed. I feel, therefore, that it is up to me to conduct a simple analysis.

I stated that less than 5 per cent. of the passenger-carrying miniature railway stock was fitted with either air or vacuum brakes—a statement that, so far, nobody has rushed in to contradict. One reader, Mr. Ford, wrote in to say that he had designed and used a system of his own quite successfully, and I personally know of a few other cases.

Most of the older readers of THE MODEL ENGINEER will remember the space given by "L.B.S.C.," some years ago, to the design and construction of complete braking systems, whilst in more recent years we have seen other well-known contributors—Mr. Hart, Senior, being one—who gave us a number of proportional steam brake valves, and which I thought were excellent.

At this point, I come to a distinct contradiction on the part of "L.B.S.C." himself. Having designed a number of braking systems, any one of which he would certainly claim to give completely satisfactory working, he now states that such a system is an "unnecessary complication" for trains of two or three cars!

As for the ball-valve in the vacuum brake system, there is at least one type of valve, very nearly as simple but much more rapid and leak-proof than the ball-valve, that I have employed for vacuum retention with very great success, and is used commercially where the simple ball-valve failed hopelessly; certain types of petrol pumps are fitted with it, and never give trouble in the valve department.

A further statement that "vacuum is vacuum" is also worthy of a little analysis. The term "vacuum" is purely relative; for example, a pressure (actual) less than 14.7 lb. per sq. in. (or atmospheric pressure) is still a *pressure* in actual terms, but is styled a partial vacuum when related to atmospheric pressure conditions. For braking purposes, a loose slide valve is held against its face by atmospheric *pressure and not by vacuum.*

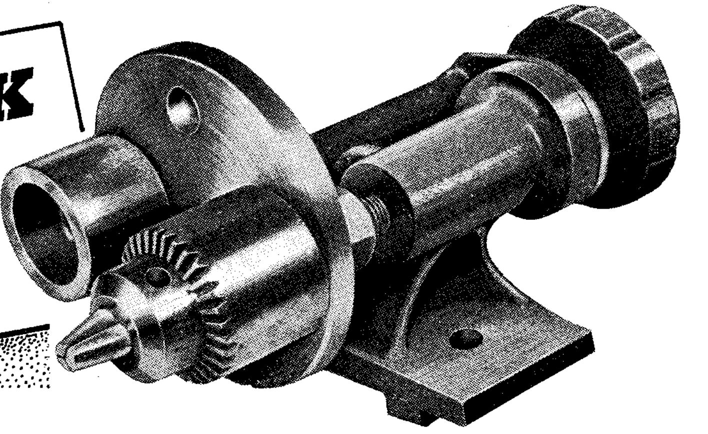
There also appears to be a state of confusion surrounding the term "triple valve." I never at any time added the word "Westinghouse," simply because I did not *mean* Westinghouse. This famous and patent valve is used exclusively in the air brake system of the same name; but there are other triple valves, "triple" signifying either three-way or three-purpose duties. The simple plug-cock is a true enough example; but it refuses to work automatically on a continuous braking system, otherwise it might have been employed before now.

It is now that I commit the unforgivable sin—*I design a triple valve of my own* which, according

(*Continued on page* 28)

A TAILSTOCK TURRET for the lathe

By D. M. Hughes



BECAUSE a model engineer pursues his craft as a hobby, he is not unduly worried by considerations of time ; nevertheless, the changing of tools and equipment on the lathe can sometimes take time and be a source of irritation. In addition, it is useful to be able to lay one's hands on the equipment when it is required !

To that end, therefore, a " Super-Adept " lathe was adapted so that industrial practice could be more or less followed. A tool-post turret was made as described in THE MODEL ENGINEER some years ago, and was found to be extremely useful in that no time is now wasted in removing and replacing tools, and fiddling about packing to centre height, etc. It was logical, therefore, that some means be devised of holding the drill chuck, die-holder, centre, etc., so that they were instantly available.

The main requirement was that the device should be fitted to the existing tailstock in such a way that it could be quickly removed and the tailstock left in a normal condition. In addition, it should not take up too much room, thus reducing the already limited distance between centres. As with all such devices, the location of the equipment must be positive on the centre line of the lathe. A turret of the conventional hexagon form had been made, but trouble was experienced in positive location, and it was too bulky.

It was decided to fit a barrel to the tailstock, parallel with the tailstock screw, and to fit a rod in this ; the rod, in turn, holding a disc of metal on which the various attachments would be fitted. Attachment of the barrel was to be by means of the lug for the locking screw at one end, and a new keep-plate at the other.

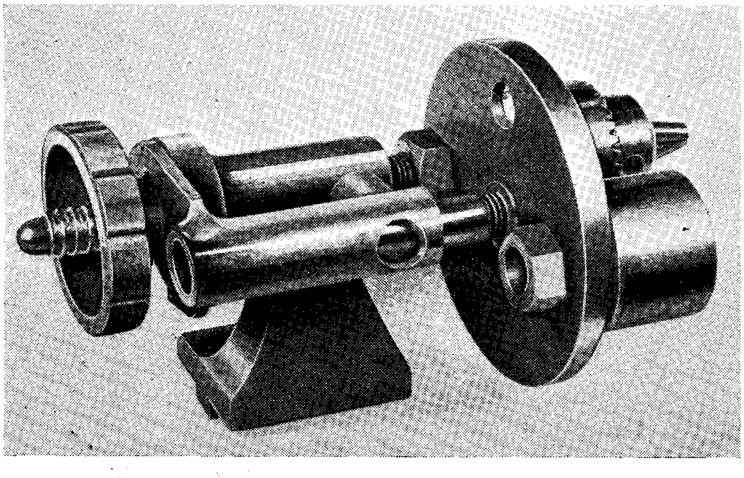
Making the Barrel

This is made of $\frac{5}{8}$ in. B.M.S., $1\frac{15}{16}$ in. long, and drilled $\frac{3}{8}$ in. At $\frac{5}{16}$ in. from one end drill a $\frac{1}{4}$ in. hole right through. Open out the hole in one side to $\frac{3}{8}$ in. and carry on through to countersink the $\frac{1}{4}$ in. hole on the inside of the barrel. Take a $\frac{1}{4}$ in. Whit. C/S screw, and turn and face until it sits in the hole, and does not project inside the barrel. Start with about $\frac{3}{8}$ in. of thread, and file down until, when it is screwed down tightly, the tailstock screw is just free. This secures one end of the barrel.

Now mark out a piece of 12-gauge brass $1\frac{3}{4}$ in. $\times$ $1\frac{1}{4}$ in. as follows :—Draw the centre line and start from one edge. Pop for drilling at $\frac{3}{16}$ in., $\frac{7}{16}$ in., $\frac{11}{16}$ in. and $1\frac{3}{8}$ in. It will be seen that holes 2 and 4 are $\frac{15}{16}$ in. apart. Drill holes 1 and 3 4-B.A. clearing. Drill hole 2 $\frac{1}{2}$ in., and hole 4 $\frac{5}{8}$ in. The $\frac{1}{2}$ in. hole is now slotted exactly as the existing keep-plate for the tailstock wheel. Fit the new keep-plate, put the $\frac{5}{8}$ in. barrel in its hole, and fix the forward end by means of its screw. Braze the barrel to the keep-plate when assembled, and file to shape. Incidentally, this, and the drilling of the barrel were the only jobs not done on the lathe. Remove the whole assembly together with the tailstock screw, and reassemble the barrel and keep-plate, without the wheel.

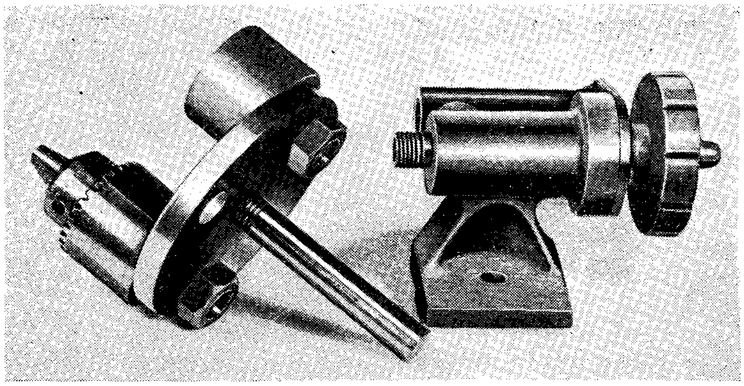
Obtain two lengths of $\frac{3}{8}$ in. silver-steel about 8 in. long. Put one in the barrel and the other in the tailstock, so that an equal amount protrudes each end. It will probably be found that these are not exactly parallel. By careful filing of the lug, they can be lined up, when tested by calipers or micrometer. The barrel securing screw may need to be filed again after this.

Take a piece of $\frac{3}{8}$ in. silver steel and thread $\frac{3}{8}$ in. B.S.F. for $\frac{3}{8}$ in. Cut off to $2\frac{1}{2}$ in. Now obtain a piece of $\frac{3}{8}$ in. steel plate about 3 in. square. Centre-pop the centre and mark off a $2\frac{3}{4}$ in. diameter circle. Drill the



Rear view of turret, showing tailstock spindle engaged in $\frac{3}{8}$-in. hole in bolt head. Note that the centre has not yet been fitted

centre ¼ in. Cut out this circle with hacksaw and file as close as possible. Set up on a ¼ in. bolt and turn the edge and face. Now to tap the centre hole. The disc would not fit any chuck or faceplate on the lathe, so the tapping was done on the drilling machine (a Union hand machine). Clamp the disc to the drill table and drill out the centre hole to ⅜ in. tapping size ($\frac{5}{16}$ in.). *Without disturbing the bracket setting*, remove the drill and replace by a centre (an old countersink will do). Tap the hole ⅜ in. B.S.F. exactly as would be done on a lathe, by steadying the tap with the centre. Remove the disc and screw on to the tapped rod. Set up in the lathe again and skim the face.



Turret and tailstock dismantled. Tailstock can be used in its normal condition

Assemble the whole turret for drilling and tapping on the lathe. Scribe two lines right across the centre of the disc at right angles. Using a centre drill in the headstock, drill four holes on the lines, feeding the disc to the drill by means of the tailstock screw. Open out two diametrically opposite holes to $\frac{5}{16}$ in. Remove the headstock chuck and insert centres. Set up a ⅜ in. B.S.F. tap between centres and tap these two holes.

Now take three ⅜ in. B.S.F. bolts about 1 in. long and threaded down to the head. Centre-drill the heads and drill ⅜ in. for a depth of ⅛ in. Screw into the disc from the rear, so that the tailstock screw can fit into the hole in the bolt head. Cut off to suitable lengths to take the drill chuck and die-holder. The screw for the die-holder should be drilled $\frac{3}{16}$ in. right through so that the threaded work can pass through the die.

Now open out one of the other two holes to ⅜ in. clearing, so that the tailstock screw can pass right through the disc if necessary. Cut the other bolt off flush and drill $\frac{3}{16}$ in.

Set up a piece of ⅜ in. silver-steel between centres, and turn one end to a replica of one of the lathe centres. Whilst it is still set up, scribe a line along its length and across the end, using a sharp tool. By using these lines, and the vice jaws, remove one half of the taper to form a " D " bit. Back off the end, and temper to a light straw. Using this boring bit, form a seating for the centre in the third bolt.

A suitable die-holder is made from a ⅞ in. length of 1⅛ in. B.M.S. This is bored out to $\frac{13}{16}$ in. for a depth of ¼ in., and drilled and tapped ⅜ in. B.S.F. A $\frac{3}{16}$ in. Whit. or 2-B.A. set-screw is fitted to hold the die.

If necessary, a tension spring can be fitted to withdraw the turret from the work, but this is optional, as withdrawal is easily made by hand.

READERS' LETTERS

(*Continued from page* 26)

to our friend, cannot possibly be any good although he has never seen it, or a description of it! The two books he mentioned are excellent works. I read them many years ago, and on frequent occasions since; but in spite of this, *I still wanted to design my own triple valve.* I must be an incurable case because I have designed many things, and they have all worked well in commercial form in every part of the world—and I am still going on designing things.

The question of the brake linkage is a slight misrepresentation on the part of our friend; the word " super " is his and not mine. I have devised a system that I like and which will work splendidly. I prefer this to any system of hydraulic parts borrowed from a motor car, and which does not conform to true railway practice. My system may not introduce new mechanical principles, but it may introduce new mechanical *applications.*

To finalise on this job of analysis, why should it be wrong for *anyone* to want to design or build something new? If we all confined ourselves to the utilisation of old and known methods, there would be no progress at all. Surely it is up to the inventive type of man to keep on designing and building new things, and trying them out. Some ideas may fail and others may succeed, but all the time man is striving to improve the methods already known. There was never any time in history when the inventive genius of man was more sorely needed than today, and to discourage the inventor would be the height of folly.

It is here, Mr. Editor, that I champion your case recently publicised in " Smoke Rings," in support of the right to free-lance in model work. We all know how horrible some free-lance locomotives can be—at least to look at; but if these are regarded merely as the growing pains of some young inventor, or the practice piece for trying out some new system or gear, they may also take their rightful place in the overall picture of small locomotive development.

Although not strictly under the present heading, I feel bound to comment upon the final section of our friend's letter.

He points out that I never published a valve gear drawing for the " Twin Sisters." Quite a large number of the builders of this locomotive have now passed the valve-gear stage—with complete success. Those to whom I have personally spoken, all say that such a drawing would have been quite unnecessary. Just as soon as my builders ask for a diagram of this kind, and with your permission regarding valuable space, Mr. Editor, it will be reproduced.

When this, or *if* this happens, it will not be a scaled down version of the prototype. I have never resorted to such a practice in my life, and never intend to do so.

Yours faithfully,

Worthing. J. I. AUSTEN-WALTON.